Virginia Conservation Assistance Program

Presented by **Virginia Association of Soil & Water Conservation Districts**

VIRGINIA ASSOCIATION OF SWCD SOIL & WATER CONSERVATION DISTRICTS

VIRGINIA CONSERVATION ASSISTANCE PROGRAM IMPLEMENTATION AND DESIGN MANUAL FIFTH EDITION, 2018

The Virginia Conservation Assistance Program (VCAP) is a stormwater management cost-share program that provides financial reimbursement to property owners installing eligible Best Management Practices (BMP's) in Virginia's Chesapeake Bay Watershed.

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Introduction to This Manual

The Fifth Edition of the Virginia Conservation Assistance Program (VCAP) Implementation and Design Manual ("Manual") is intended to assist Soil and Water Conservation District (SWCD) personnel as they implement VCAP. VCAP was pioneered by a Grant Sub-Committee of the Virginia Association of Soil and Water Conservation Districts' (VASWCD) Urban Committee and was originally based upon the North Carolina Community Conservation Assistance Program (NCCCAP), modified as appropriate to conform to best management practices accepted by the Virginia Department of Environmental Quality (DEQ).

The purpose of this program is to provide cost-share and technical assistance to address natural resource and stormwater concerns by assisting in the voluntary installation of certain stormwater Best Management Practices (BMPs) on land for which there is no other cost-share program assistance available. VCAP also aims to assist localities with the Municipal Separate Storm Sewer System (MS4) implementation and the challenges meeting the Chesapeake Bay Total Maximum Daily Load (TMDL) goals.

This Manual is to be a resource for District staff as they provide technical assistance needed to *guide* the proper siting, selection, design, installation, and maintenance of stormwater BMPs on eligible lands. These BMPs are intended to capture and/or infiltrate surface runoff produced immediately following a 1-inch rainfall event, on average. <u>These BMPs are primarily designed to manage stormwater coming from a source on the property, such as a roof, driveway or lawn</u>. Sites with contributing offsite runoff can also be addressed with the practices in VCAP, but may require more extensive planning and engineering.

Where applicable, this document references the Non-Proprietary BMPs of the Stormwater Design Specifications contained in the Virginia Stormwater BMP Clearinghouse (http://vwrrc.vt.edu/swc/NonProprietaryBMPs.html). Users will also find the *Virginia Agricultural Cost Share (VACS) BMP Manual* and technical manuals of the Natural Resources Conservation Service (NRCS) helpful for fulfilling the intentions of VCAP.

The Manual is divided into three parts. Part I summarizes the background and history of the development of VCAP and its administrative framework. Part II contains background information on stormwater management and the Chesapeake Bay. Part III contains the design standards for all VCAP BMPs.

PART I – PROGRAM DEVELOPMENT AND IMPLEMENTATION

Section 1.1 Background and Development of VCAP

The Virginia Conservation Assistance Program (VCAP) is based upon the North Carolina Community Conservation Assistance Program (NCCCAP). Like VCAP, NCCCAP provides financial help to landowners in urban, suburban, and rural areas to control erosion and runoff on non-agricultural properties.

NCCCAP was designed to retrofit water quality Best Management Practices (BMPs) onto already-developed non-agricultural land. Several districts within the state, particularly Mecklenburg SWCD, broadened their scope of resource protection and developed local community conservation assistance programs, and thus developed model programs potentially applicable across the entire state.

Encouraged by these efforts, the North Carolina Association of Soil and Water Conservation Districts (NCASWCD) pursued the development of a statewide community conservation program. Through the strong support of district supervisors, the North Carolina Soil and Water Conservation Commission received authorizing legislation to establish the NCCCAP through Session Law 2006-2008. The North Carolina Division of Soil and Water Conservation began the program using grant funds to demonstrate recognizable results across the state. In July 2007, the program received its first state appropriation. Over the succeeding five years additional financial support was used to expand the program throughout the state.

Hoping to replicate this successful program, in 2011 the VASWCD's Urban Committee sought a Chesapeake Bay Small Watershed Project Design Grant from the National Fish and Wildlife Foundation (NFWF) to support the establishment of design components for a program focused on filling "urban" gaps identified in Virginia's Watershed Implementation Plan (WIP) for the Chesapeake Bay TMDL. The WIP noted that the "new stormwater regulations will not address sediment and nutrient loads associated with existing development, nor does the existing Chesapeake Bay Preservation Act . . . [To] fill this gap, new requirements, as well as financial incentives for stormwater BMPs are needed."

The Urban Committee's Grant Sub-Committee was primarily comprised of representatives from four Districts -- Culpeper, Hanover-Caroline, Piedmont, and Thomas Jefferson -- all of which played active roles with the design of VCAP.

The remainder of this Manual is the result of their collaborative work, and is partially based on the *North Carolina CCAP Program Manual, July 2007* (as partially updated through March 2012) and the *North Carolina Division of Soil and Water Conservation Community Conservation Assistance Program Stormwater Management Practice Design Manual*, and conforms with the Non-Proprietary BMPs of the DEQ Design Specifications contained in the Virginia Stormwater BMP Clearinghouse where necessary for Virginia programmatic purposes, as well as to the format and content of the *Program Year 2012 Virginia Agricultural Cost Share (VACS) BMP Manual*.

Section 1.2 Program Scope and Eligibility

A. Program Scope

Districts have a successful history of promoting the voluntary installation of water quality BMPs on agricultural lands through the Virginia Agricultural Cost-Share (VACS) program. VCAP expands this capacity by enabling Districts to promote efforts for corrective action on developed lands, hereafter described as "retrofitting." Retrofitting reduces the amount of sediment, nutrients, and other contaminants reaching streams and rivers. Properly managed stormwater can help recharge groundwater and protect the land and streams from erosion. Financial incentives to help encourage the installation of stormwater BMPs will help Virginia meet its non-point source pollution reduction water quality objectives.

While VCAP is designed to encourage the installation of stormwater BMPs on developed land, it is understood that resource-based problems affecting water quality occur on all land uses. For this reason VCAP, at this time, is not limited to strictly urban settings, but includes situations where there is no other cost-share program currently offered to implement a water quality improvement BMP. Broad eligibility criteria will allow VCAP to accomplish several priorities that are not limited to the treatment of stormwater in urban settings. A ranking system is used to help prioritize the recruitment of participants and the implementation of BMPs, with a minimum ranking score to be determined by the VCAP Steering Committee, based on funding. Applicants must meet all program requirements in order to proceed beyond the application phase.

B. Program Eligibility

1. Development:

VCAP is not eligible to be used to assist new development sites to meet any local, state, or federal stormwater mandates. VCAP is intended to retrofit existing infrastructure. At the end of three years after the developed site has been completed and stabilized and an occupancy permit has been issued, an applicant is eligible to submit an application.

2. Participants:

VCAP is eligible to public, private, non-profits, and commercial landowners within a participating SWCD and in the Chesapeake Bay watershed, where there is no other cost-share program currently offered to implement a stormwater management water quality improvement BMP. State- and federally-owned land does not qualify. A practice is not eligible for VCAP funding if it corresponds to an equivalent BMP in an agricultural cost-share program (such as DCR VACS or NRCS), regardless of whether the applicant receives funding for the corresponding BMP in an agricultural cost-share program.

3. Flooding:

VCAP is not eligible to address major flooding issues on existing development. Flooding, as defined by the Stormwater Management Act, is "a volume of water that is too great to be confined within the banks or walls of the stream, water body, or conveyance system and that overflows onto adjacent lands, thereby causing or threatening damage." VCAP may be used to address smaller scale localized flooding as long as there is no channelization of stormwater runoff and the drainage pattern remains unchanged. Localized flooding, as defined by the Virginia Stormwater Management Regulations, means "smaller scale

flooding that may occur outside of a stormwater conveyance system. This may include high water, ponding, or standing water from stormwater runoff, which is likely to cause property damage or unsafe conditions."

4. Municipal Separate Stormwater Sewer Systems (MS4):

Per subsection C (2b) (1) of Section 1 from 9VAC25-890-40, sites within designated MS4 localities can be eligible for funding. Funded practices may be used as credit toward any local stormwater utility fees. These practices may not be used to trade credits to regulated activities. Funded practices must meet or exceed the baseline removal requirement for the site before the MS4 locality can report the BMP for load reduction credit. Funded practices that do not meet the baseline removal requirements for the site will be reported by VCAP.

Section 1.3 Goals and Objectives of VCAP

The overall program goal is to encourage owners of eligible land in all VCAP Districts to install stormwater BMP retrofits that will provide nutrient and/or sediment reductions that can be credited toward accomplishing Virginia's Chesapeake Bay TMDL goals by offering cost-sharing financial incentives. VCAP will accomplish the following objectives to meet the program goal:

A. Maintain a suite of BMPs consistent with the Virginia Stormwater BMP Clearinghouse, as appropriate, and a subset of BMPs appropriate for VCAP.

B. Identify environmental benefits associated with BMPs including load reductions associated with Chesapeake Bay TMDL implementation efforts.

C. Maintain BMP specifications that may be required beyond those provided by the Virginia Stormwater BMP Clearinghouse.

D. Maintain partnerships between Districts and local government to ensure local support of VCAP.

E. Establish support for VCAP through partnerships with community groups.

F. Continue to develop and maintain VCAP information and outreach materials.

G. Identify and establish contacts with other funding programs and partner agencies to maintain strategies to secure continued funding for VCAP.

H. Develop and maintain a training curriculum for District Staff.

Section 1.4 District Responsibilities

Local implementation of VCAP is the responsibility of the participating Districts under the direction of their Board. The charge for Districts is to execute VCAP to satisfy a recognized non-point source pollution problem. Districts are to place the highest priority on water quality improvement and protection.

A. All program-related meetings will comply with the Open Meetings Law (Va. Code § 2.2- 3707 *et seq*.). Districts will ensure that the District Board meets often enough to properly execute and oversee VCAP in their Districts. The VCAP Steering Committee recommends that District Boards meet to review their VCAP activities monthly, although this is not a requirement for participation in the program.

B. Each District that chooses to participate in VCAP will publicize the program year and/or when new sources of VCAP funds become available. Districts shall assess outreach opportunities and determine marketing approaches.

C. Districts will accept applications and may develop specific criteria for their District delineating how and when applications will be accepted.

D. Districts will utilize the ranking system in the VCAP manual when evaluating applications that are submitted to the VCAP Steering Committee. However, Districts can develop an additional ranking system to assist with this determination. This would be similar to the "Secondary Considerations" that the VACS program utilizes. If the District Board establishes a secondary ranking system or policy, it should be recorded in the meeting minutes and submitted to the Steering Committee.

E. District boards will approve forwarding applications to the VCAP Steering Committee. The Steering Committee will provide technical review and approve allocation of funding.

F. Incomplete applications to the VCAP Steering Committee will not be considered and will be returned to the District until all information is received. Refer to checklist in the District Reference Guide for all required information.

G. After the application is considered by the VCAP Steering Committee, the District will be notified by the VCAP Program Coordinator ("Coordinator") of the status along with cost-share funds that may have been allocated.

H. When BMPs are installed, District staff will certify that the installation meets the requirements of Part III of this Manual. A reimbursement request to the VCAP Steering Committee is submitted. The committee will review the reimbursement request. After committee approval, Districts may disburse payment based on the approved amount of VCAP funds allocated to their project.

I. Districts are responsible for conducting annual spot checks of twenty five percent (25%) of all active contracts executed in their District to ensure on-going maintenance. Districts are to document the number and names of all persons participating in the spot check process. Spot checks will be performed by appropriate technical staff and may include a member of the VCAP Steering Committee.

J. Districts will ensure that participants adhere to the maintenance agreement. Participants found to be out of compliance are notified pursuant to the guidelines found in Part I, Section 1.8 ("Compliance & Corrective Actions") of this Manual, and written and photo documentation of the noncompliance and resolution becomes a part of the District files. Districts will also ensure that the VCAP Steering Committee receives notification of noncompliance and the subsequent resolution of such noncompliance.

K. Districts shall ensure that BMP maintenance is continued regardless of transfer of control of property (see Part 1, Section 1.7).

L. Districts will exercise all jurisprudence to avoid any actual or perceived conflicts of interest in implementing VCAP.

Section 1.5 VCAP Steering Committee Role

The role of the VCAP Steering Committee is to provide programmatic guidance to ensure VCAP continues to accomplish the overall goal of enabling participants to install BMPs that reduce the flow of nonpoint source pollution into local waterways and ultimately the Chesapeake Bay. The Steering Committee is also responsible for providing guidance on continued funding and legislative issues related to VCAP that may arise.

The Steering Committee will include the following members:

- A representative staff member of at least four, but not to exceed six, participating Districts;
- A representative of the Virginia Association of Soil and Water Conservation Districts (VASWCD); and
- The Chair of the VASWCD Urban Committee, or approved representative of the Urban Committee. The Urban Committee member is responsible for keeping Urban Committee members informed of the progress of VCAP, to encourage other Districts to adopt VCAP, and to determine collaborative opportunities with the larger Urban Committee based on its Plan of Work.

As VCAP evolves, the central focus of the Steering Committee should include long-range planning and goals, further Manual development, and critical policy and technical recommendations, feedback, and expertise. Review and approval of practices, payments, and technical assistance will fall to the Steering Committee. Day-to-day operations, outreach, and branding of the program will fall primarily to the VCAP Program Coordinator (hereafter "Coordinator"). Any agreements made through an MOU with Steering Committee districts, such as technical training, financial management, and attending monthly meetings will constitute the remainder of Steering Committee District obligations.

Primarily, Steering Committee members provide critical feedback and assistance to the Coordinator through their years of experience in the field, technical knowledge, and past experience with VCAP.

Specifically, the Steering Committee will:

- Convene monthly meetings to discuss ongoing programmatic development, provide guidance to the Coordinator, and take part in long-range and strategic planning for VCAP
- Review and approve cost-share applications, cost-share payments, and technical assistance payments
- Approve program level issues such as Manual revisions, BMP criteria, and any changes to official VCAP policies
- Provide feedback on branded materials, outreach content, and other Coordinator roles in general
- Assist with District outreach and relationship building through promoting and discussing VCAP, including mentorship of new districts and "Southern Rivers" districts wishing to create their own pilot program.
- Provide program feedback to the VASWCD on VCAP issues, challenges, or future plans based on experience and program feedback by participating Districts throughout the Chesapeake Bay watershed.

- Continue to oversee the Technical Advisory Committee (TAC) to continually develop and improve BMP specifications and Manual language
- Record and post minutes from monthly Steering Committee meetings and TAC sessions

Section 1.6 Technical Advisory Committee Role

The Steering Committee is responsible for creating and maintaining a Technical Advisory Committee (TAC). The TAC is responsible for evaluating and providing technical advice to the Steering Committee regarding BMPs in VCAP. Membership consists of a proportional representation of participating Districts and other individuals by invitation from the Steering Committee. Approximately three-fourths of the TAC is composed of licensed and certified professionals, and contractors or stormwater industry representatives that are involved in landscaping and stormwater management. The TAC should meet at least once per year and may meet at any time appropriate to conduct business for VCAP.

The TAC is encouraged to solicit input by Districts participating in VCAP, other Non-Program Districts, or other specialty organizations or agencies on various issues including types of BMPs, BMP specifications, and average BMP costs. *TAC members are not representatives of VCAP and may not lobby on its behalf.*

Section 1.7 Funding Allocations, Payments, and Participant Responsibilities

A. Funding Allocations

VCAP is funded by a variety of state, federal, and private grants. These include Chesapeake Bay Implementation Grant (CBIG) funds through Virginia DEQ and Chesapeake Bay Innovative Nutrient and Sediment Reduction (INSR) funds through the National Fish and Wildlife Foundation (NFWF). Under these grants, the portion of all districts falling within the Chesapeake Bay watershed in Virginia qualify for the program, which is operated and managed by the VASWCD. Cost-share funding is maintained at a Chesapeake Bay-wide level and will be allocated based on ranking criteria that will be utilized by the VCAP Steering Committee to evaluate applications on a monthly basis. The ranking criteria will be consistently administered when considering any application for approval. There are no per-district allocations, and cost-share rates/caps are the same for all Chesapeake Bay Districts, which are reviewed and set per grant cycle.

The allocation of funds will be administered by the Steering Committee with support from the Coordinator, an employee of the VASWCD. The funds will be reimbursed to the District upon project completion.

All projects approved by the Steering Committee during a given calendar year must be completed by June 1st of the following calendar year. All projects approved by the Steering Committee must begin work within 90 days of approval in order to still qualify for cost-share payment. Districts should contact the Coordinator if they foresee obstacles in completing projects before the deadline.

Occasionally there may be costs that are incurred during construction that exceed the cost-share amount originally approved by the Steering Committee. In these cases, the District may request an increased cost-share payment by submitting **Form 7** to the Steering Committee prior to final payment. The increased costs must be unavoidable and must be necessary for the proper

functioning of the BMP. The costs must also be within the scope of the design plan that was approved by the Steering Committee prior to the beginning of construction. The decision to award the increased cost-share payment is at the discretion of the Steering Committee.

Please note that any applicant may pair VCAP cost-share funding with other grant sources or cost-share programs to fund a particular project. **Please note that VCAP funds, partnered with other such resources or not, may never exceed one hundred percent (100%) of the total cost for completing the project.**

B. Submission

The process to apply for reimbursable cost-share funding begins by completing **Form 1 (Contract)**, which specifies the type of BMP to be installed and the total estimated cost, and by submitting a **Form 2 (Job Sheet)**. The property owner must sign the application forms to qualify. At least one contractor estimate is required in the application packet (unless the applicant will be constructing project themselves, in which case, the applicant will need to submit the estimated volunteer labor hours and cost using the federal volunteer labor rate). The Steering Committee will not accept estimates based on District cost lists.

The applicant must have a current federal tax form W-9 on file with the District to assure that correct tax information for the applicant is available for reporting purposes. A 1099 tax form will be issued to applicants based on the W-9 data on file, for payments of $600 or greater in a calendar year.

Participants may not begin any construction until the application is approved by the District Board and approved by the Steering Committee. If participants begin construction before their application is approved, they will not be eligible to receive cost-share for that project.

District staff are to review the Contract and design plan for compliance with VCAP policies as described in the VCAP Manual. This should include a site assessment report identifying the current condition of the site and any resource concern(s) and how they will be addressed by the BMP(s). Districts are to rank each project using the VCAP Ranking Sheet **(Form 6)** and provide this ranking sheet to the Coordinator.

District staff submits the final application to the Coordinator **(Form 1, Form 2, Form 6, and clear photos of the site required at time of submission)**, who reviews the application for completeness. Each month, applications will be presented to the Steering Committee for consideration and approval. Final approval of practice funding is the responsibility of the local District Board of Directors. All actions taken must be voted upon and the outcome recorded in the minutes of the meeting where such action is taken.

Once approved, the VCAP participant signs the Landowner Agreement **(Form 3)** confirming the amount of cost-share approved, agreeing to allow district staff to access the property under specified terms, and specifying other terms of the agreement.

If a participant does not begin work within 90 days of Steering Committee application approval, the District shall follow up with the participant and request justification for failure to start the project within 90 days. An extension may be granted if the participant provides a justification deemed reasonable by the Steering Committee, such as waiting for the appropriate planting season. Hiring a contractor or purchasing materials qualifies as starting a project; obtaining a permit does not qualify.

Projects must be completed by June 1st of the calendar year following the approval of the

application.

C. Verification and Payments

Once a practice has been installed and subsequently inspected by a District staff member, a **Request for Payment should be submitted to the Coordinator, along with a signed Form 1, Part C and supporting photos.** Once final payment is approved by the VCAP steering Committee, the District is expected to make the approved cost-share payment to the participant. VCAP will reimburse the district for the full cost-share amount. Refer to the VCAP Payment Request Checklist for a list of documents that must be submitted to the Coordinator before the Steering Committee can approve a reimbursement payment.

If it is not possible for the District to make cost-share payments on larger projects before being reimbursed, the district may wait until cost-share funds are received from VCAP. Reimbursement will be made to the District for each completed contract and will include $500.00 in Technical Assistance (TA) funds per practice. While there is no minimum cost-share payment eligible for participation in VCAP, Districts will not receive a TA payment for practices receiving less than $100.00 in cost-share funds. It is the discretion of the participating District whether or not to accept these "micro" practices.

Districts must submit a third-party as-built certification when necessary. Districts should be prepared to verify and document that their cost-share payments are being spent in accordance with the administrative and technical guidance published in this manual.

D. Participant Responsibilities

Maintenance agreements between the involved parties are acceptable but ultimate responsibilities still rest with the participant.

The Operation and Maintenance Plan further describes the participant's obligations to maintain the BMP. The participant is responsible for the maintenance of the BMP for the entire lifespan of the practice, regardless of changes in the ownership of the land. In cases where a change in ownership of the land occur, such as the sale of the property, or any changes in lease agreements, the participant may complete an Agreement Transferring BMP Responsibility **(Form 4)** to relieve them of responsibility for the practice by transferring it to the new owner. If this form is not completed, the participant continues to be the responsible party regardless of ownership of the subject property.

E. Reporting Completed Practices

The Coordinator will report completed practices to the appropriate tracking program. The reportable data will be collected on the Job Sheet (Form 2).

F. Guidance on Volunteer Hours

This guidance provides clarification for allowing volunteer hours that have value in the calculations to determine cost-share payment amounts. VCAP does not restrict the source of the labor that a participant may utilize and submit as a cost associated with the implementation of approved BMPs. Applicants choosing to utilize volunteer labor must submit such labor as part of the cost estimate in the application packet. The application packet shall outline the anticipated number of volunteer hours needed to install the BMP. Volunteer labor eligible to receive cost-share is restricted to the labor required for installation of the BMP, and **the maximum number of**

volunteer hours eligible to receive cost-share is 12 hours. To calculate the cost of the estimated volunteer hours, applicants should use the federal volunteer rate of the year the application will be presented for approval.

Districts must ensure that the labor charges submitted are in line with the Total Eligible Estimated Cost that was the original basis for the amount of cost-share approved for BMP installation. Further, the justification of the labor submitted for calculation of the cost-share reimbursement payment is at the discretion of the Steering Committee.

Section 1.8 Program Compliance and Corrective Action

A. Spot Checks

Spot checks are verification inspections meant to determine practice existence and viability during the lifespan of the practice and are not intended as a technical inspection. Technical accuracy was determined by a District staff member at the time of completion.

1. Random practice verification inspections will be conducted by District staff under the guidance of the Coordinator to determine that the individual practice is still viable. The District should keep all inspection forms and photo documentation on file for at least the lifespan of the practice.
2. For vegetative practices, spot checks should be conducted at a time of active growth.
3. A random 25% selection of all active projects will be checked by the District annually.
4. Upon completion of the spot checks, District staff must, at the next regularly scheduled Board meeting, inform the District Board of any corrective action needed. A copy of all spot check forms shall be sent to the Coordinator. Copies of each form shall be maintained in the District files.
5. Spot check reports on practices receiving cost-share from other sources should be copied to the appropriate agency.
6. The Coordinator will consolidate all spot check information into a table indicating how many inspections were conducted, how many practices were in compliance, and how many practices require additional District follow up. A copy of this report should be provided to the Steering Committee. The report will be used by the Coordinator to assure that practices needing additional District attention receive the appropriate follow-up and that all issues are resolved or the appropriate amount of cost-share funds are repaid to the District.

B. Corrective Action

District staff shall maintain written and photo documentation of practices failing to meet specifications. Failure to maintain the practice for the specified lifespan (10 years for all practices) will result in the participant being required to refund all or part of the cost-share amount. The required repayment amount is based on the amount of funding provided to the participant prorated to the lifespan remaining. In the case of the death of the participant this requirement may be waived. This determination requires an official action of the District Board that must be recorded in the minutes. A Transfer of Responsibility waiver (Form 4) should be signed if the property changes ownership during the life of the BMP.

Participants found to have practices not meeting specifications or practices destroyed during the

designated life span will be contacted by the District and informed of the nature of the deficiency and repayment requirements if not corrected. This should initially be a verbal notice (with the date documented in a case file). Verbal notice should be followed with a written notice (by certified mail) within two weeks. This notice must indicate the observed nature of the problem and allow the individual the opportunity to respond within two weeks.

Participants may be given a maximum grace period of six months from the date of the written notification for practice compliance. At the end of the grace period, the practice will be re-inspected. The District will notify participants found with practices still not in compliance in writing that repayment of state or other cost-share funds is required.

Participants will have 60 days from the date of the District's notification of repayment to refund the cost-share funds. If restitution has not been made at the end of this 60-day period, the District will notify the Virginia Office of the Attorney General (OAG) for assistance to reclaim the funds. It is recommended that the OAG be apprised of the need for assistance as soon as the deadline for recovery has passed.

C. Cost-share Repayment Hardship Process

This process may be utilized when a participant requests that the requirement for the repayment of cost-share funds due to the failure of a BMP be forgiven due to unusual circumstances beyond the participant's control. The circumstance(s) must be of a severity such as a life-threatening illness, bankruptcy, or some other situation out of the participant's control, including but not limited to natural disasters. This process may not be used to provide relief associated with practice specifications or operation and maintenance agreements, such as requirements for maintaining a percentage of vegetative cover. All requests for hardship shall be submitted in writing to the Coordinator, and the decision to grant the cost-share repayment hardship exemption is at the discretion of the Steering Committee.

Section 1.9 Cost-Share Rates and Caps

Assigned cost-share rates and caps will apply to all applications received from a participating District during a given grant cycle. Rates for each practice are described in further detail in the **District Reference Guide**. All applicants will be limited to $50,000.00 in total cost-share received per calendar year, based on date of application approval. One contiguous BMP cannot have more than one application from the same property owner(s) regardless of property boundaries nor will the VCAP program accept multiple applications from adjacent property owners for the same contiguous project.

Permit fees are not an eligible component cost for any practice and therefore cannot receive cost-share. Contractor design fees are an eligible component cost under VCAP. As with all eligible costs, design fees will be subject to review by the Steering Committee to determine if costs are reasonable in comparison to project scope. Contractor fees for completing VCAP Forms or meeting VCAP specifications will not be allowed. This is the responsibility jointly of the property owner and District staff.

PART II –STORMWATER OVERVIEW

Section 2.1 Introduction of BMPs

The specifications and application of BMPs are constantly evolving with new information and more experience. The specifications and standards found in this Manual will be updated as more research and information is gathered. This document focuses on retrofit BMPs that can be installed in small scale settings, such as existing individual residences and small businesses.

Stormwater BMPs found in this Manual:

Section 2.2 Stormwater Overview

A. Definitions of Stormwater

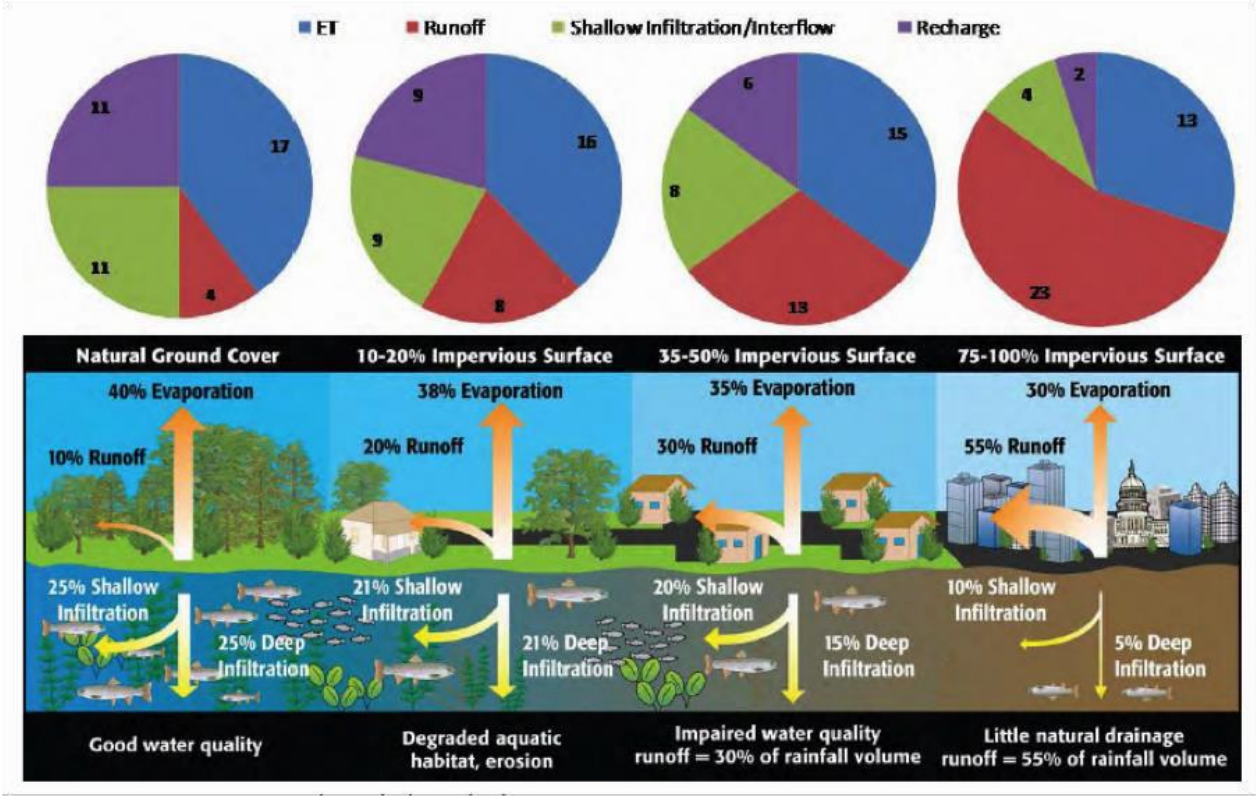
Stormwater describes surface runoff from disturbed and developed lands that is produced immediately following a rainfall event or as a result of snowmelt. Factors that affect stormwater include the quantity and intensity of a precipitation event, amount of impervious surfaces, the soil type and condition, vegetative cover, and slope length and steepness. The Virginia Stormwater Management Program defines the term as "precipitation that is discharged across the land surface or through conveyances to one or more waterways and that may include stormwater runoff, snow melt runoff, and surface runoff and drainage."

B. Effects of Urbanization

Virginia is among the fastest growing states and the resulting urban influx affects many facets of the state's infrastructure. More cars drive our roads, more people create higher wastewater discharges, and more development necessitates stormwater runoff controls.

How does urbanization affect stormwater runoff? Roads, parking lots, sidewalks, homes, and offices replace the natural, permeable landscape. Rainfall that once soaked into vegetated ground is now available as stormwater runoff. Impervious surfaces connect to form a "stormwater superhighway" that allows runoff to reach streams more quickly. The following diagram illustrates

how stormwater runoff is a function of impervious cover.



Stormwater Runoff as a Function of Impervious Cover (Potomac Conservancy, 2008)

There are many impacts from this increase in impervious cover: (1) more stormwater reaches streams because there is less opportunity for it to infiltrate into the ground; (2) peak flows increase because the "stormwater superhighway" transports runoff from large areas rapidly; (3) velocities in the stream increase, causing more erosion; and (4) base flow is lower during dry weather due to a lack of infiltration into the underlying groundwater (groundwater recharge).

Although Virginia passed legislation to manage stormwater pollution in 2004, sediment remains a major pollutant of our waters. In addition, metals and chemicals from vehicles and industries pollute stormwater runoff in increasing amounts. Likewise, nutrients are found in the urban environment in a variety of forms, such as fertilizer used on lawns and deposition from the air. Fertilizer contains nutrients for plants to grow, but excess fertilizer, or fertilizer that is inadvertently applied to pavement, harms water quality.

Section 2.3 Stormwater Best Management Practices (BMPs)

A. Overview of Stormwater BMPs

Stormwater management is the attempt to reduce runoff volume, control peak flow rate, and improve water quality using BMPs. Each BMP has certain conditions under which it will function properly. Site conditions such as amount of stormwater discharge, soil-type, slope, available land, impervious surface, and proximity to waterways all influence the selection of a BMP.

The Environmental Protection Agency (EPA) has identified two distinct classifications of BMPs- "nonstructural" and "structural."

Nonstructural BMPs reduces stormwater quantity and improve water quality at the source. There are some simple non-structural practices that homeowners can implement themselves. Some examples include downspout disconnection, sheet flow to open space, grass channels, replacing managed turf with native plants, and amending soil.

Structural BMPs are engineered systems that control the peak flow, reduce runoff volume, and improve stormwater quality. Some examples of these are Bioretention (BR) areas, Rain Gardens (RG), Rainwater Harvesting (RWH), Green Roofs (GR), and Constructed Wetlands (CW).

B. Practice Selection

BMP selection will be based on resource concerns and site conditions and will include applicant objectives. **Sites should have an identifiable water quality issue, and BMP objectives must address the identified resource concern(s) and shall be limited to practices that capture and reuse or treat stormwater.** Measures to only reduce flooding will not be eligible for cost share. The VCAP Site Assessment Tool can be used to assess the site conditions and help determine the best practice to address the water quality issue.

Cost-share funds must be used to install the most effective BMP needed to address the resource concern. If several BMPs are installed on the site as part of a "treatment train," they must all be necessary to address the resource concern, and the most effective BMP must be installed first. All practices necessary to solve the water quality problem should be installed regardless of whether they receive VCAP cost-share funds. For example, a buffer should not be installed in an eroding lot unless the erosion problem on the property is also addressed.

The selection of the most effective stormwater practice depends on the nature of the terrain, the intensity of development, and the sensitivity of the receiving water. Districts may refer to the DEQ Stormwater BMP Clearinghouse, which provides a matrix to help determine which practices are recommended, acceptable, restricted or prohibited based on areas of karst, coastal plain, trout watersheds, ultra-urban watersheds and stormwater hotspots.

Examples:

- Sites with known erosion problems and poor drainage could consider improving the stormwater conveyance system.
- Sites which have water volume issues and an onsite need for water could consider Rainwater Harvesting (RWH) to collect and reuse stormwater.
- Sites that produce high levels of pollutants could consider a conversion of land management practices that changes how the land is used to reduce pollutant generation.
- A combination of objectives can be satisfied with one or more practices, and practices can be combined to create "treatment trains" to accomplish all objectives.

C. Accounting for Chesapeake Bay Model Credits

Since the first Chesapeake Bay Agreement in 1983, Virginia along with the other states in the Chesapeake Bay watershed have been trying to reduce and reverse the adverse impacts of sediment and nutrient pollution to the Bay. As earlier efforts to reduce point source sediment and nutrient pollutants bore success, efforts have increasingly turned to the growing problem of nonpoint sources of sediment and nutrients. To reflect the growing concern of untreated runoff that results from agriculture and the proliferation of untreated runoff from urban and residential development, the Bay Agreement was updated in 1987, 2000, and 2014.

The insufficient progress of cleanup and the continued impairment of the Chesapeake Bay led to the insistence that Chesapeake Bay TMDL levels be determined for nitrogen, phosphorous, and sediment. Each state within the Chesapeake Bay watershed was required to develop Watershed Implementation Plans (WIPs). The WIPs detailed the strategies each state will implement to meet TMDL allocations (*see Fact Sheet: Chesapeake Bay TMDL, 12/29/10*).

The VCAP BMPs are intended to address Virginia's WIP strategies and to be accountable for achieving a level of pollution reduction in accordance with the Urban BMPs of the Chesapeake Bay Model. Pollution reduction under the Model is determined based on a BMP's pollutant removal efficiency rate, a pollutant load reduction, or a land use change. Since most of the VCAP BMPs are derived from the Virginia Stormwater BMP Clearinghouse, there is assurance of verification of those BMPs with the Chesapeake Bay Model and accountability towards meeting Virginia's WIP strategy goals.

Appendix C contains Sheet 2 of an NPS BMP DET V10 matrix used by the Chesapeake Bay Program to evaluate BMP data elements, and Sheet 3, an example VCAP project tracking spreadsheet.

Section 2.4 General Stormwater BMP Design Considerations

2.4.1 Water Quality Treatment

A. The "First Flush" Concept and Treatment Volume Approach

The term "first flush" has become common nomenclature in the stormwater management field. The concept behind this term is that pollutants that have collected on impervious surfaces will wash off during the first part of a storm event. The "first flush" contains more pollutants than stormwater runoff produced later in the storm. In theory, if the "first flush" could be captured and treated by a stormwater practice, 90% of the pollutants leaving the site could be treated by the stormwater practice (Schueler and Holland, 2000). However, it has been found that a Treatment Volume approach provides better pollutant removal performance by the BMPs than the "first flush" approach. The following is from Chapter 5 of the September 2012 Virginia Stormwater Management Handbook. Based on these findings, the Treatment Volume approach will be emphasized by future stormwater programs in Virginia and is utilized by VCAP:

The Treatment Volume is a variation of the first flush concept that is based on a regional analysis of the mid-Atlantic rainfall frequency spectrum. Treatment volume (Tv) becomes the storage volume that stormwater BMPs provide water quality treatment. Treatment Volume is derived from the Simple Method for pollutant load using the 90th percentile rainfall event and the site cover coefficient. In Virginia, the 90th percentile rainfall event is defined as 1-inch of rainfall. The rationale for using the 90th percentile event is that it represents the majority of runoff volume on an annual basis.

The proposed Treatment Volume (Tv) has several distinct advantages when it comes to sizing BMPs for water quality treatment:

- *Storage is a direct function of impervious cover and disturbed soils, which provides designers incentives to minimize the area of both at a site.*
- *The Tv approach provides adequate storage to treat pollutants for a range of storm events.*

This is important since the first flush effect has been found to be modest for many pollutants (Pitt et al, 2005).

- *The T_v provides effective stormwater treatment for approximately 90% of the annual runoff volume from the site, and larger storms will be partially treated.*

T_v provides an objective measure to gauge the aggregate performance of environmental site design, Runoff Reduction, and Pollutant Removal BMPs together using a common currency (runoff volume).

B. Disconnection

Impervious areas that immediately drain to a stormwater conveyance system, such as inlets, culverts, and open channels, are considered to be "connected impervious" areas and produce stormwater that flows untreated to surface water bodies. For example, if a rooftop drains to a gutter, which then drains directly onto a nearby street and into the street storm drainage, this would be considered an example of "connected impervious."

Disconnection occurs when impervious surfaces are redirected and dispersed into sheet flow across an expanse of turf grass or natural vegetation. Runoff from disconnected impervious areas is routed to a pervious area where it has a chance to infiltrate. As a general rule, impervious surfaces must sheet flow for at least 40 feet before it reaches some kind of conveyance system, before it may be considered a disconnected impervious surface for runoff calculation.

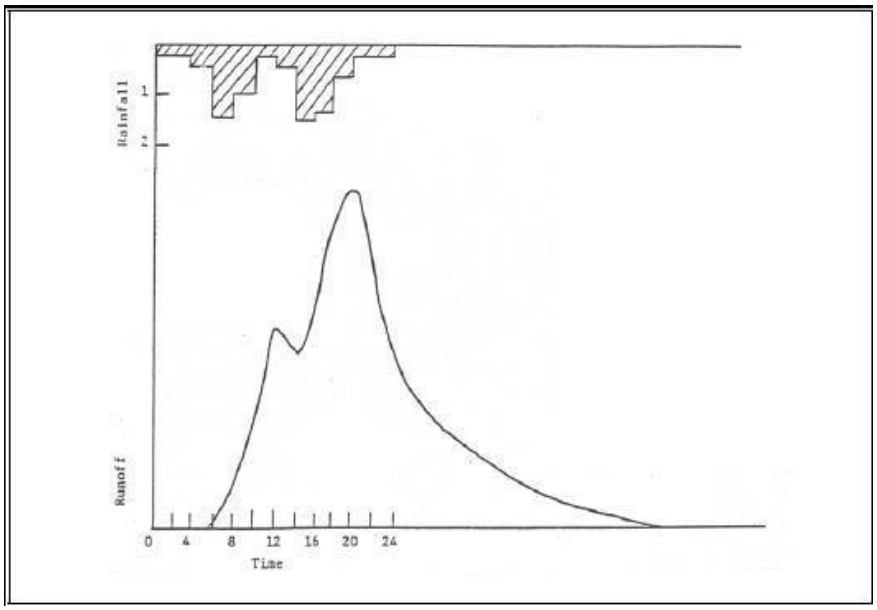
C. Pollutant Load Treatment

The "Simple Method" is a technique that can be used to calculate the anticipated pollutant load that will leave a given residence or small business (Schueler, 1987). The information required to employ the Simple Method is: (1) the area that will be draining to the proposed BMP location in acres, (2) the percentage of the drainage area that is impervious, (3) the annual regional rainfall, and (4) pollutant concentration. The Simple Method calculates storm intensity in a two-step process using a runoff coefficient to calculate runoff depth (inches), which is then used to determine the annual pollutant load (lbs./year). Instructions on using the Simple Method can be found in Appendix A (Calculations Specific to VCAP BMPs).

2.4.2 Water Quantity Control

A. Peak Flow

Determining the peak flow leaving a watershed during a storm is important when designing many stormwater BMPs. The peak flow is the period when the greatest volume of water leaves the watershed through the course of a storm event. The following graph shows a sample flow versus time relationship and its associated peak flow. The depth of rain that falls throughout the event can be observed on the right side of graph.



Peak Flow Illustration (Figure 4-4 Virginia Stormwater Management Handbook, Volume 2, 1st edition 1999)

The peak flow is used to determine the capacity of stormwater conveyance systems and size BMP outlet structures. See Appendix A.2 for detailed calculations.

B. Dispersing Stormwater

Stormwater collects and concentrates very easily in depressions, swales, natural runoff conveyances, Rain Gardens (RG), and Rainwater Harvesting (RWH) cisterns. If possible, backyard stormwater BMPs should have an overflow connection to an existing stormwater drainage pathway. The current drainage path can be utilized as a way to convey water away from the BMP should a storm occur that is larger than what the BMP is designed to hold.

2.4.3 BMP Components

A. Pretreatment and Inlet Control

Pretreatment is a necessary component of many stormwater BMPs. Pretreatment is a process to reduce pollution in stormwater before it is introduced into a stormwater BMP. Pretreatment is usually performed to reduce constituents, such as sediment, that may interfere or substantially reduce the effectiveness of a stormwater BMP. Pretreatment requirements for stormwater BMPs covered by VCAP can be found in Appendix B.

B. Outlet Structure

Close attention should be paid to where the water from a stormwater BMP exits a given property. During small rain events, depending on soil conditions, all the stormwater produced in a small watershed may be retained in the BMP. However, during larger rainfall events the stormwater BMP will fill to capacity and spill over into the adjoining area.

There are three types of outlets to consider: underdrains, orifices, and weirs. An underdrain is a perforated pipe that collects excess water from a filtering practice and is typically connected to a storm sewer system or “day lighted” into a conveyance system. An orifice is a part of a control structure that includes a riser and barrel through an earthen embankment. Orifice outlets typically

connect to a storm sewer system or "daylights" into a conveyance system. A weir is a notch in the earthen embankment similar to an open channel. Weirs can be a vegetated, stone or concrete and they typically discharge runoff overland as sheet flow. Selection of an outlet is dependent on the stormwater BMP and location of an adequate conveyance system.

Special care should be taken to ensure that the area into which the outlet discharges is able to convey the stormwater safely to a nearby conveyance system, such as an inlet, culvert or open channel. The procedure for determining the appropriate outlet size can be found in Appendix A.3

2.4.4 Compliance with Local, State, and Federal Codes

A. Permits

The type, size and location of the BMP may require compliance with local zoning ordinances and local, state and federal permitting. A Joint Permit Application (JPA) should be submitted when impacting wetlands and streams. If the size of the BMP disturbs enough land to qualify as a land disturbing activity, then a local land disturbing permit may be needed. These BMPs must comply with the local program ordinance and the Virginia Erosion and Sediment Control Regulations.

B. Riparian Buffers

Riparian buffers help to absorb periodic flood surges; supply thermal protection, food, and cover to fish and other wildlife; stabilize stream-banks; filter runoff; and provide recreation and aesthetic values.

Riparian buffer rules in certain localities can impact the function and siting of a backyard stormwater BMP. All participants should confer with their local governments, as well as their local SWCD, to determine if proposed BMPs may be impacted by local riparian buffer requirements.

2.4.5 Considering Soil Conditions

A. Soil Fertility

Stormwater BMPs are impacted significantly by the soil in which they are constructed. Therefore, it is important to know which soil types are present at a given location before designing or constructing a stormwater BMP. The presence of restricted layers such as shallow bedrock, high water table, and compacted clay may affect construction and design of stormwater BMPs. Soil properties such as hydraulic conductivity, texture, and linear extensibility affect site infiltration rates. Soil nutrient levels (N-P-K), pH and cation-exchange-capacity (CEC) affect vegetation establishment. When a site is evaluated for a practice, determining the soil type at the site can be performed first by referring to soil surveys for general soil characteristics but should ultimately be determined from field investigations.

B. Soil Surveys

Soil Surveys are comprehensive reports on soil resources of a given county. These publications include maps with soil boundaries, aerial photos, narrative descriptions of each soil map unit and tables explaining specific soil properties and features. District staff should become familiar with the soil survey of their particular counties. It is important to note that soil surveys may not be accurate to the site scale level. Visit the Web Soil Survey for more information.

C. Site Investigations

Soil information gathered solely from a soil survey should not be used exclusively to determine which type of soil is present at a given site. A site investigation is needed to verify that the soil on site is suitable for a given BMP, especially those intended to provide infiltration. Infiltration information can be gathered in two ways: first, by testing for presence of wetland soils, and secondly, by testing for permeability.

To test for wetland soils, dig a test hole in the location of the proposed BMP that is approximately 2 feet deep, or to the depth of the bottom of the proposed BMP, whichever is deeper. As the hole is being dug, the soil should be observed for signs that it is a wetland soil. Wetland soils are commonly grey with ribbons of brown. If wetland soils are identified within 1 foot of the surface at a given site, the site is likely poorly drained. Please refer to the following publications for more detailed descriptions of wetland soils:

- Vepraskas, M.J. 2015. Redoximorphic Features for Identifying Aquic Conditions. Tech. Bull. 301. NC Agric. Exp. Stn., Raleigh, NC.
- Field Indicators of Hydric Soils in the United States: A Guide for Identifying and Delineating Hydric Soils, Version 8.1, 2017)
- NRCS webpage: Identifying Wetland Boundaries

To test for permeability, conduct a simplified soil infiltration test. This is a test to check the permeability of the soils being evaluated for BMP suitability. A hole should be dug using an auger or spade, approximately 1 foot below the expected bottom of BMP. The newly dug hole should be filled with a known amount of water. Monitor how quickly the hole drains and use this information to select the appropriate BMP. The drainage rate is particularly important for plant selection and bottom grading of the practice.

2.4.6 Maintenance

Once construction is completed, periodic inspections must be performed to ensure the BMP continues to function as designed. Maintenance is a necessary component of all BMPs. All participants must be aware of the operation and maintenance responsibilities for the proposed BMP. These responsibilities, as noted in the BMP-specific Operations and Maintenance Plan found in the Job Sheet (Form 2) attached to the Landowner Agreement (Form 3), may influence BMP selection. District staff should discuss the following maintenance requirements with all participants:

A. Routine Maintenance

Routine maintenance may include landscaping and aesthetic maintenance such as grass, tree and shrub care, wetland plant care, re-seeding and mulching, slope stabilization, grass mowing, pruning, filling and repair of gully erosion, repair of shoreline, animal control, removal of invasive vegetation and minor sediment cleaning. It also may include removal of debris, trash, sediment, vegetation and other matter that impedes or threatens to impede stormwater functioning or structural integrity.

B. Non-Routine Maintenance

Non-routine maintenance may include the repair or replacement of structural components such as embankments, risers and outlet barrels, trash racks and anti-vortex devices, emergency spillways, pretreatment forebays, seepage controls, drains, water quality or quantity control

devices, outlet protections or energy dissipaters, shoreline stabilization, and major sediment removal (excavation or dredging methods).

2.4.7 Problems Regarding Multiple Property Owners

Before a site is chosen for a stormwater BMP, the property boundaries must be clearly defined by the property owner and verified if possible by District staff. This is to ensure that no part of the proposed BMP is to be located on property belonging to an individual not participating in VCAP. If a stormwater BMP is to be located in such a way that multiple property owners will be impacted, all property owners must be contacted and must agree upon the BMP measures in the project contract, and be noted in the Landowner Agreement Form 3. However, it is the ultimate responsibility of the landowner who signs the VCAP contract.

Additionally, stormwater BMPs are designed to slow and capture stormwater before it leaves a given property, thus a pool of water may form as water slows and enters the BMP. This pool of water should not extend to a neighbor's property without written consent in the project contract. It should also be noted that downstream property owners usually benefit from their upslope neighbor's installation of backyard BMPs, which bring about a potential reduction in flooding and erosion on the downstream owner's property. This benefit should be clearly communicated to the non-participating landowners as part of the development of the BMP project.

PART III: NEW BMP RETROFITS

Section 3.0 General Policies

A new "retrofit" occurs when a BMP is installed that creates storage to reduce nutrients from existing developed land that is not currently receiving any stormwater treatment (CBPWQGIT, 2012). These stormwater practices are built near stormwater outfalls or within existing stormwater conveyance systems; adjacent to large parking lots or other impervious areas; within right-of-ways; and on individual residential properties.

The practices in this section are organized by the level of engineering required for their design. When engineering is required, the practices are further divided by scale or scope of the project. As a guideline, the following is the assigned level of engineering for the BMPs in this section:

Basic practices generally require no engineering in their installation and minimal planning. These can generally be planned and installed by a participant with minimal District assistance.

3.1 Impervious Surface Removal (ISR)

3.2 Conservation Landscaping (CL)

Intermediate practices require more extensive planning and may require some engineering and thus may require the participant to hire a skilled contractor with some engineering expertise.

3.3 Rain Garden (RG)

3.4 Dry Well (DW)

3.5 Constructed Wetland (CW)

Advanced practices require extensive planning, the hiring of a skilled contractor or engineer, and installation certification.

3.6 Vegetated Stormwater Conveyance (VSC)

3.7 Rainwater Harvesting (RWH)

3.8 Bioretention (BR)

3.9 Infiltration (IF)

3.10 Permeable Pavement (PP)

3.11 Green Roof (GR)

3.12 Living Shorelines (LS)

The selection of the most effective stormwater practice depends on the nature of the terrain, the intensity of development, and the sensitivity of the receiving water. The DEQ Stormwater BMP Clearinghouse provides a matrix to help determine which practices are recommended, acceptable, restricted or prohibited based on areas of karst, coastal plain, trout watersheds, ultra-urban watersheds and stormwater hotspots.

Release Agreement for Advanced BMPs:

Depending on the scale of the practice, a Release Agreement (Form 5) may be used to waive the requirement for the design plan to be certified with a stamp from a licensed professional. The Steering Committee must be notified when a participant requests waiving this requirement. The following will be used by Districts as a guide for that determination in accordance with the scale tables below.

- Local Districts may approve the waiver for Small Scale projects.
- The Steering Committee may approve the waiver for Medium Scale projects
- Large Scale projects cannot waive the requirement for a design plan to be stamped by a licensed professional. All Level 2 designs are considered Large Scale projects.

Scale	Rainwater Harvesting	Vegetative Stormwater Conveyance	Bioretention	Infiltration	Permeable Pavement	Green Roof	Living Shoreline
	Treated Volume (Gallon)	*Slope Gradient (%)*	*Size (Square feet)*				*Fetch (mile)*
Small	< 650 Gal.	< 2%	< 300 sq. ft.		< 1,000 sq. ft.	< 400 sq. ft.	NA
Medium	< 3,000 Gal.	< 4%	< 1,500 sq. ft.		< 5,000 sq. ft.	< 1,000 sq. ft.	< 0.5 mile
Large	> 3,000 Gal.	> 4%	> 1,500 sq. ft.		> 5,000 sq.ft.	> 1,000 sq. ft.	> 0.5 mile

Policies Regarding New BMP Retrofit Practices

Detailed standards for each BMP are discussed in subsequent sections of this chapter. Where applicable, these BMP standards are based on the specifications of the Virginia Stormwater BMP Clearinghouse to be consistent with the Chesapeake Bay TMDL WIP. Below are the design standards that pertain to all practices within Section 3.

A. Eligibility

- Practices are not intended to meet regulatory requirements.
- Practices funded through this program cannot be used for Nutrient Trading.
- Cost-share funds must be used to install the most effective BMP needed to address the resource concern. If several BMPs are installed on the site as part of a "treatment train," they must all be necessary to address the resource concern, and the most effective BMP must be installed first. All practices necessary to solve the water quality problem should be installed regardless of whether they receive VCAP cost-share funds. For example, a buffer should not be installed in an eroding lot unless the erosion problem on the property is also addressed.
- All practices detaining and/or infiltrating runoff must be sized to treat a 1" rainfall volume as

per the DEQ Stormwater BMP Clearinghouse specifications.

B. Lifespan Requirements of VCAP Projects

- All practices must be maintained for 10 years.
- Once installed, projects should be considered permanent landscape features and an effort should be made to provide for continuation beyond VCAP commitment.

C. Ranking Criteria for VCAP Funding

Each application will receive a numeric ranking score based on water quality improvement parameters. Applications with higher ranking scores will receive priority for funding allocations. See the VCAP Ranking Sheet in the **District Reference Guide**.

D. Plans and Specifications

- The participant is responsible for ensuring that the proposed project construction and subsequent maintenance meets all applicable local, state and federal permits, policies and ordinances.
- Design plan and Job Sheet (Form 2) shall include the following:
  - Sketch and aerial photo showing the location, specifications, contributing drainage area, impervious area(s) treated, dimensions of the practice, and project layout
  - Photos of the site, including the resource concern(s)
  - Cross section showing the depth, slope, inlet, outlet and overflow structures where applicable
  - Material list and itemized cost estimates. Plant list can include the common plant name but must include the scientific name. Annual plants, vegetables, and herbs are not allowed in the landscape plan.
  - Site constraints for construction should be identified
  - Installation requirements including site preparation, construction sequence, and site stabilization
  - Necessary computations per the practice standards (i.e. practice sizing calculations). An infiltration test should be conducted to a minimum depth of 12 inches, and the infiltration test results must be submitted with the application.
  - Operation and maintenance plan for the lifespan of the practice

E. Operation and Maintenance

- All practices will be subject to spot checks by SWCD staff during the practice's lifespan.
- Participant must accept maintenance responsibilities for the practice per an approved Operation and Maintenance Plan found in the Job Sheet (Form 2), attached to the Landowner Agreement Form 3. This agreement will include specific maintenance objectives described for each BMP.

F. Technical Responsibility

- The participant will be responsible for submitting all project plans. Technical guidance may be provided by local SWCDs. All projects must meet local codes, ordinances, and policies, and must address any permitting requirements.
- The local SWCD is responsible for reviewing all plans, providing any necessary technical guidance, and inspecting the completed practice to ensure that all standards have been met prior to issuance of payment.
- District staff that provides assistance and approval of projects must have a basic understanding of non-point source pollution and pollution reduction in Virginia. Stormwater and Erosion and Sediment Control certification is preferred.
- A licensed or certified professional is responsible for certifying design plans for advanced practices. Should a VCAP participant choose to assume the responsibility and forgo a licensed, engineered design, a Release Agreement Form 5 shall be signed.

G. Cost-Share and Incentives

- Itemized cost estimates are needed to determine the maximum cost-share amount.
- If a practice requires a pre-treatment, the pre-treatment costs are included in the primary practice cost estimate.
- Incentives are flat payments that do not exceed the total cost of installation.

H. Planning Considerations

- Miss Utility notification (Call 811).
- Setbacks from dwellings/buildings, septic systems, and wells shall follow guidelines per the practice standard.
- Infiltration test (USDA NRCS Soil Quality Test Kit Guide. Soil Quality Institute. July 2001. Section I Part 3. Page 7-8. Or Appendix 8-A on the Virginia Stormwater BMP Clearinghouse)
- Soil Compaction Test (see Penn State Extension Agronomy Facts 63 or Bulk Density Test USDA NRCS. Soil Quality Test Kit Guide. Soil Quality Institute. July 2001. Section I Part 4. Page 9-13.)
- Soil Fertility Testing (see VCE PUB 425-125 and 425-129)

Section 3.1 Impervious Surface Removal (ISR)

Surfaces covered by impenetrable materials such as asphalt, compacted gravel, concrete, brick, and stone are impermeable. These impermeable materials seal surfaces, repel water, and prevent precipitation from infiltrating into soils and groundwater. Removal of these impermeable materials, when combined with permeable pavement or vegetation establishment, is intended to reduce stormwater runoff rate and volume, as well as associated pollutants transported from the site by stormwater runoff.

The process of urbanization, characterized by increases in impermeable or impervious areas, causes a substantial increase in stormwater runoff. One obviously beneficial stormwater management practice is to reduce the amount of impervious surface area in a given urbanized area. If an area has already been urbanized, this can be accomplished by removing impervious areas that can be replaced with pervious areas and still serve the intended purpose.

Policies Regarding ISR

Patios, walkways, parking areas, driveways, and other impervious surfaces can be converted to pervious areas that increase infiltration to groundwater. Gravel driveways and walkways more than three years old are considered an impervious surface. Gardens, lawns, and permeable pavers can be used in place of the impervious area removed. In order for impervious surface removal costs to be offset by VCAP, they must be accompanied by an approved stabilization plan. This practice is considered to be a nonstructural BMP.

- ISR can be a standalone practice when not followed by the installation of a VCAP BMP, i.e. the site beneath the removed surface is stabilized with grass or non-native plants.
- When ISR is followed by the installation of a VCAP practice, ISR will become a component of that practice, and the cost-share of that practice will increase to account for the cost-share rate for ISR (with the exception of permeable pavement). In these situations, the applicant would submit one application for the primary BMP with ISR as a component.

- When ISR is followed by permeable pavement, ISR will become a component of that practice, but the applicant will not receive additional cost-share for ISR. In these situations, the applicant would submit one application for PP with ISR as a component.

A. Criteria

- This BMP is not intended for impervious surface removal associated with roof removal (associated with structure removal).
- Removal must include the impervious surface and sub-grade aggregate. The materials removed must be properly disposed.
- The subsoil shall be scarified at least 2 inches below the compacted subgrade aggregate.
- The practice must include a plan for vegetation establishment or permeable pavement installation.
- When vegetation is to be established on site, the practice should be initiated as closely as possible to the optimum time for vegetation establishment. Temporary conservation cover must be established within 14 calendar days if permanent vegetation cannot be established. Vegetation establishment must include proper soil preparation, which requires a soil test. Deep tillage using a chisel plow, ripper or sub-soiler may be required to address soil compaction. Addition and incorporation of topsoil or organic matter may be necessary for proper seedbed establishment.
- Incorporate soil compost amendments if the intention is to have the newly pervious surface act as a riparian buffer or filter strip.

B. Plans and Specifications

- A design plan for the site must be submitted by the applicant and approved by the Steering Committee before construction is initiated. The installed practice must be in accordance with the approved design unless changes were pre-approved by the Steering Committee. Information required in the design plan includes (see VCAP Submission Checklist for a comprehensive list):
  - Total impervious surface area to be removed and detailed map of the site.
  - A plan for fragmenting, removal and disposal of existing impervious cover.
  - A plan for soil preparation, which must be supported by a soil test.
  - A plan for final site stabilization.
  - Expected timeline for completion.
  - Erosion and Sediment Control Plan, if applicable

C. Operation and Maintenance

- Maintenance Inspection of the planted area shall be conducted annually by the landowner, or a designated sub-contracted agent of the landowner.
- Site specific maintenance items depending on final stabilization plan.
- Ensuring full vegetative cover remains intact and invasive species are controlled if vegetation is used.

- No impervious surface built over the treated area.

D. Cost-Share Rates

- See **District Reference Guide** for practice cost-share rates and caps.
- Eligible costs may include: demolition (removal and disposal of surface material and aggregate), soil testing, seedbed preparation (harrowing/raking/amending soil), permanent seed, mulch, sod, erosion and sediment controls when needed.

E. Helpful Technical References

- Conservation Landscaping BMP in this Manual (see Section 3.4 below).
- Permeable Pavement BMP in this Manual (see Section 3.11 below)
- VA Stormwater Clearinghouse Design Specification No. 4 Soil Amendments.
- VA Erosion and Sediment Control Handbook Standard and Specification 3.30 – Topsoiling.

Section 3.2 Conservation Landscaping (CL)

This practice encompasses the conversion of managed turf grass areas or bare soils to areas planted in native herbaceous and woody species. Managed turf is defined as grassed soil that no longer functions in its natural hydrologic state due to disturbance, compaction, or excessive management (West Virginia Department of Environmental Protection). Converting managed turf or bare soils into highly functioning ecosystems collectively in a community can have beneficial impacts on local water quality and that of the Chesapeake Bay.

Native plants are generally best adapted to local soil and climate conditions and therefore require the least amount of nutrient addition or cultivation in order to maintain the amount of ground cover best suited to minimize runoff. In contrast, turf grasses and non-native species generally require both continual maintenance and periodic fertilization in order to provide the same amount of stormwater runoff protection. Therefore, the conversion of managed turf or bare soils to native plants will generally be beneficial from a non-point source runoff pollution prevention standpoint.

The nutrient load of a residential lawn has been estimated at between 2 and 9.7 mg/L/year of nitrogen and between 0.3 and 1.9 mg/L/year of phosphorus (*Chesapeake Stormwater Network Technical Bulletin No. 9, 2011*).

Policies Regarding CL

There are three conservation landscaping practices covered under this standard: Meadow, Tree Planting, and Mulched Bed. Tree planting may be used for establishing a Riparian Buffer along a waterway or pond. A Meadow may be used as a Filter Strip when receiving runoff from impervious surfaces. This practice is considered to be a nonstructural BMP, unless used as a Filter Strip.

Conservation landscaping shall be eligible to receive cost-share only if it addresses a nutrient or sediment resource concern, such as bare soil or regular lawn fertilization. Photo documentation

and District verification of the resource concern(s) must be provided in the application.

A. Criteria

- Perennial native species that are adapted to the site conditions must be used. Therefore, selected species must have the capacity to achieve adequate density and vigor within an appropriate time frame to stabilize the site sufficiently to permit suited uses with ordinary management activities. Plant species must be considered native "Flora of Virginia." **Only native plants** will be allowed in a conservation landscaping plant list or planting plan. See *Helpful Technical References* section for publications and websites related to native plants. Invasive or noxious species, as identified by the DCR invasive species list, and/or the USDA noxious weed list are prohibited. The Steering Committee reserves the right to deny applications and/or withhold cost-share payments from any projects that install invasive or noxious species.
- Vegetation establishment must include proper soil preparation. Deep tillage using a chisel plow, ripper or sub-soiler may be required to address soil compaction. Addition and incorporation of topsoil or organic matter may be necessary for proper seedbed establishment.
- This practice should be initiated as closely as possible to the optimum time for vegetation establishment. Temporary conservation cover must be established within 14 calendar days if permanent vegetation cannot be established.
- Mowing shall be limited according to the approved Operation and Maintenance Plan described in the Job Sheet Form 2. Mowing of grass under tree plantings shall be limited to four times per year.
- A meadow should include a seed mix with at least two (2) native grass species and nine (9) forbs/wildflower species. Alternative Seed Mix ratio may be considered. Competition controls must be included with the final plans. Competition controls should be described in greater detail in the site specific plan submitted before installation. A temporary cover is necessary when there will be two (2) burn downs separated by a growing season.
- Tree plantings are required to be native species. Diversity is encouraged for larger scale projects. Appropriate tree protection measures must be employed, such as tree shelters, weed barriers, tree wraps, or other methods approved by the Steering Committee.
- Mulch Beds may be a mix of native woody and herbaceous plant species and must include suitable mulch at least 3 inches thick. Landscape edging could be eligible for cost-share when adjacent to invasive ground cover and impervious surfaces.
- Wet areas not suitable for Rain Gardens or pocket wetland practices may be converted to a wet meadow under Conservation Landscaping. This should be used in areas where standing water or saturated soil limits vegetative cover to less than 90% and contributes to a water quality concern downstream.
- Required density and minimum ground covers for all plantings will be based on mature size of approved species within the approved site-specific plans. Suggested spacing: Plugs – 6 inches; perennials – 1 foot; grasses – 2 to 3 feet; small shrubs (< 6 feet tall) – 3 to 5 feet; large shrubs (> 6 feet tall) – 6 to 8 feet; small trees (<25 feet tall) – 25 feet; medium trees (<40 feet tall) – 30 feet; large trees (>40 feet tall) – 35 feet. See VDOF recommendations for tree saplings in the *Helpful Technical References* section.

- Fertilization, mulching, or other facilitating practices for plant growth must be timed and applied to accelerate establishment of selected species, and must not be a requirement for vegetation maintenance. Soil amendments will be added only as demonstrated necessary according to a soil test report. Only the minimum amount of fertilizer necessary to establish vegetation growth shall be utilized (according to soil test report).
- Measures to exclude pests that will interfere with the timely establishment of vegetation must be employed.
- If the planting area is to serve as a *Filter Strip or Riparian Buffer*, the following criteria should be followed:
  - A robust stand of vegetation should be established.
  - Slope gradient shall be less than 8% for Filter Strips.
  - Minimum width of 35 feet for slope gradients less than 4%. Minimum width of 50 feet for slope gradients 4 to 6 percent. Minimum width of 65 feet for slope gradients of 6 to 8 percent. Riparian Buffers with slope gradients over 8 percent shall have a minimum width of 100 feet.
  - Runoff onto the Filter Strip should be evenly dispersed with an adequate pretreatment measure. See appendix B
  - Impervious area to Filter Strip should be less than 5,000 square feet.

B. Plans and Specifications

- A planting plan for the site must be submitted by the applicant and approved by the Steering Committee before construction is initiated. The installed practice must be in accordance with the approved design unless changes were pre-approved by the Steering Committee. Information required in the planting plan includes (see VCAP Submission Checklist for a comprehensive list):
  - Type of Conservation Landscaping.
  - Square footage of the area being planted.
  - Linear feet of stream being buffered (if applicable).
  - Total drainage area of the site and the amount of impervious surface draining to the project. Only applicable for Filter Strip applications.
  - Slope of the land.
  - Plan to control and/or eliminate unwanted existing vegetation.
  - Landscape planting and mulching plan including: species, rate of seeding or planting, minimum quality of planting stock, and method of establishment. Plant list can include the common plant name but must include the scientific name. Vegetables, herbs, and annual plants are not allowed in the landscape plan. Only viable, high-quality seed or planting stock should be used. Soil types must be documented and any soil amendments required as a result of a soil test must be completed. Include the amounts, timing and method of application of each amendment.

C. Operation and Maintenance

- Maintenance of the planted area will be conducted annually by the landowner, or a designated sub-contracted agent of the landowner.

- Maintenance will include:
  - Annual survey of planted area to evaluate for invasive species and plant survival/success. Vegetation must achieve an overall survival rate of 75% throughout the ten-year maintenance agreement period.
  - Spot treat invasive species to limit ground cover to less than 5%.
  - If needed, mow high (6-10 inches) no more than twice a year, either before or after nesting season (typically early March or mid-August).
  - Trash should be removed at least annually.
  - Issues of trespass, leading to damaged vegetation, will be addressed as necessary.
- Applying fertilizer after vegetation has been established is prohibited as one of the purposes of VCAP is to reduce sources of nutrient pollution.

D. Cost Share Rates/Incentives

- See **District Reference Guide** for practice cost-share rates and caps.
- Eligible costs may include: soil testing, site preparation (herbicide, sod removal, harrowing, raking), installation (broadcast, drill, or planting), temporary and permanent seed, plants, mulch, soil amendments (compost and lime), tree shelter, weed barriers, erosion and sediment controls when necessary.

E. Helpful Technical References

- USDA NRCS Conservation Cover: Wildflower Meadow for Wildlife and Pollinators. Virginia Conservation Practice Job Sheet 327. 2011.
- USDA NRCS Riparian Forest Buffer. Conservation Practice Job Sheet 391. 1997.
- NRCS Virginia Plant Establishment Guide. 2011.
- Dorner, Jeanette. An Introduction to using native plants in restoration projects. National Park Service. 2000.
- Homeowner Guide to Make your Property Bay Friendly. Chesapeake Stormwater Network. June 19, 2013.
- Native Plant Resources:
  - Native Plant Center (ACB)
  - Digital Atlas of the Flora of Virginia
  - Flora of Virginia Project
  - Native Plants for Conservation, Restoration & Landscaping
  - Virginia Native Plant Society

Section 3.3 Rain Garden (RG)

A Rain Garden is a shallow landscaped depression that incorporates many pollutant removal mechanisms including temporarily ponding stormwater runoff 6 to 12 inches above a mulch layer that encourages the rain water to infiltrate into the underlying native soil within 48 hours.

Policies Regarding RG

Rain Gardens should be designed to treat runoff from small areas, such as individual rooftops, driveways and other on-lot features in single-family detached residential developments. Inflow is typically from a downspout with energy dissipaters or can be sheet flow from a driveway/patio or lawn. This practice is intended for disconnecting impervious surfaces.

A. Criteria

- Practice should be located within 40 feet of downspout or contributing impervious surface.
- Project drainage area will not contain more than 0.5 acres at 25% impervious cover, unless the total project drainage area is less than 10,000 square feet in which case impervious area will not be greater than 2,500 square feet. Drainage area calculations must include impervious area.
- Rain Gardens shall be sized with the following method (Fairfax County, 2009). Dp is the depth of ponding in feet. All practices detaining and/or infiltrating runoff must be sized to treat a 1 inch rainfall volume as per the DEQ Stormwater BMP Clearinghouse specifications.

Impervious Surface (sq. ft.) x [(0.95/12)/Dp] = _____ sq. ft.

Pervious Surface (sq. ft.) x [(0.25/12)/Dp] = _____ sq. ft.

Total Surface Area (Impervious + Pervious) = _____ sq. ft.

- Alternative sizing methods may be considered on a case-by-case basis. Multiple Rain Gardens for a large drainage area are encouraged to keep the maximum size to no more than 300 sq. ft. per cell (excavated ponding area).
- The site must have subsoils capable of infiltrating stormwater runoff. Compost amendments are used when the infiltration rate is greater than 0.5 inches per hour; engineered soil media is needed when the infiltration rate is less than 0.5 inches per hour; and an underdrain or alternative practice is needed when the infiltration rate is less than 0.25 inches per hour. If the need for soil replacement or underdrain is identified, the participant should consider a Bioretention practice.
- The subsoil of the ponding area will be amended with compost to achieve 5% organic matter content. Typically, compost is applied at a 4:1 ratio (soil to compost) usually 1 inch of compost incorporated into 4 inches of soil. A compost amendment rate calculator similar to the SoilsforSalmon.org tool may be used.
- Only the minimum amount of fertilizer necessary to establish vegetation growth shall be utilized (according to soil test report).
- Rain Gardens will not be placed in wetland soil or within the 100-year flood plain.
- Rain Gardens should retain surface water for less than 48 hours after a storm event.
- Depth to water table and bedrock shall be greater than 2 feet.
- Impact from location of proposed Rain Garden on septic drain fields and foundations should be evaluated prior to application approval. Consult local setback requirements.
- A stable stormwater overflow route must be available or provided.
- Splash blocks or gravel diaphragm shall be used as pretreatment for each point of concentrated runoff entering the Rain Garden. See Appendix B for other acceptable pretreatment measures.
- All vegetated areas that drain to the Rain Garden must be maintained in full vegetative cover with no scour areas.
- Planting and mulching and all other site stabilization measures must occur immediately after constructing the Rain Garden. Seasonal exceptions can be made.
- Plant selection for the project site must include some native Virginia species, but is not strictly limited to them. However, only native plants will be eligible to receive cost-share funds. Invasive or noxious species, as identified by the DCR invasive species list, and/or the USDA noxious weed list are prohibited. The Steering Committee reserves the right to deny applications and/or withhold cost-share payments from any projects that install invasive or noxious species.
- Required density and minimum ground covers for all plantings will be based on mature size of approved species within the approved site-specific plans. Suggested spacing: Plugs – 6 inches; perennials – 1 foot; grasses – 2 to 3 feet; small shrubs (< 6 feet tall) – 3 to 5

feet; large shrubs (> 6 feet tall) – 6 to 8 feet; small trees (<25 feet tall) – 25 feet; medium trees (<40 feet tall) – 30 feet; large trees (>40 feet tall) – 35 feet. See VDOF recommendations for tree saplings in the *Helpful Technical References* section.

B. Plans and Specifications

- A design plan for the site must be submitted by the applicant and approved by the Steering Committee before construction is initiated. The installed practice must be in accordance with the approved design unless changes were pre-approved by the Steering Committee. Information required in the design plan includes (see VCAP Submission Checklist for a comprehensive list):
  - An infiltration test should be conducted to a minimum depth of 12", and the infiltration test results must be submitted with the application.
  - Provide calculations verifying sizing and outlet capacity.
  - Landscape plan including: species, rate of seeding or planting, minimum quality of planting stock, and method of establishment. Only viable, high-quality seed or planting stock should be used. Plant list can include the common plant name but must include the scientific name. Vegetables, herbs, and annual plants are not allowed in the landscape plan.
  - A statement regarding compliance with any permitting requirements.
  - Other information as requested by the local District.
- It is the VCAP participant's responsibility to ensure any contractors meet all local codes and requirements.

C. Operation and Maintenance

- Maintenance inspection shall be conducted annually by the landowner or a designated sub-contracted agent of the landowner.
- First-year maintenance will include:
  - Weekly watering during the growing season as necessary to ensure survival.
  - Stabilizing bare or eroding areas as necessary.
  - Replacing dead plants and removing invasive species.
- Maintenance will include:
  - Spot weeding, erosion repair, and removal of trash, debris, and invasive species at least twice a year or as needed.
  - Tree and shrub mortality will be addressed annually by replanting the species with adequate protection and support to ensure survival.
  - As needed, supplement wood mulch to maintain a 3-inch layer.
  - Ensure all vegetation stabilization measures remain intact and all runoff flow routes function properly.
  - Pruning vegetation in the spring is recommended to accommodate new growth.
- Applying fertilizer after vegetation has been established is prohibited as one of the

purposes of VCAP is to reduce sources of nutrient pollution.

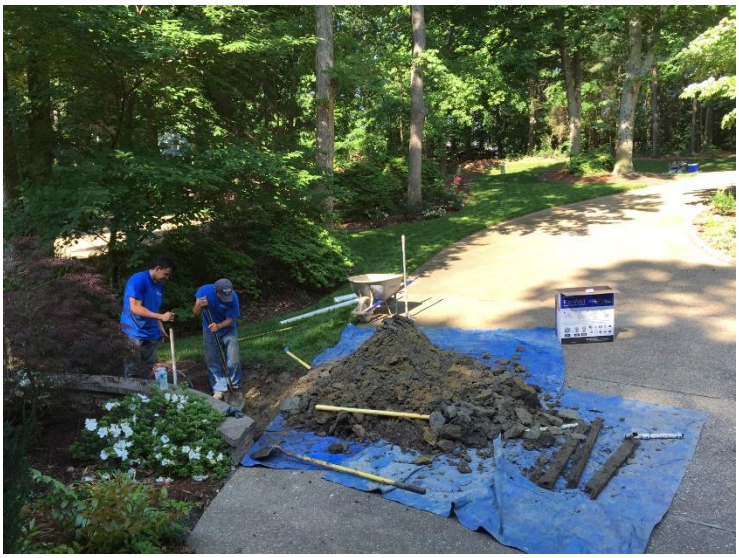
D. Cost-Share Rates/Incentives

- See **District Reference Guide** for practice cost-share rates and caps.
- Eligible costs may include: soil testing, excavation, grading/amending soil, plants, seed, installation costs (planting/seeding), compost, mulch, pre-treatment costs, engineered soil, and underdrain components (pipe, stone) when necessary.

E. Helpful Technical References

- Rain Garden Design and Construction: A Northern Virginia Homeowner Guide. Fairfax County, Va. 4/2009.
- Virginia Stormwater BMP Clearinghouse Design Specification No. 1 and No. 9.
- Rain Garden Landscape Templates for the Mid-Atlantic.
- Virginia Cooperative Extension Urban Water Quality Management Rain Garden Plants. Pub 426-043.
- Cogger, Craig. Compost Amendment Rate Calculator. Washington State University.

Section 3.4 Dry Well (DW)



A Dry Well is a subsurface storage facility that receives and temporarily stores stormwater runoff from roofs of structures. Discharge of this stored runoff from a Dry Well occurs through infiltration into the surrounding soils. A Dry Well may be either a structural chamber and/or an excavated pit filled with gravel.

Policies Regarding DW

This practice is designed to treat runoff from small areas, such as individual rooftops, driveways, and other on-lot features in single-family detached residential developments. Inflow is typically from a downspout but sheet flow over an impervious surface can be treated by a Dry Well if the appropriate pretreatment measure is installed to prevent clogging. However, applicants may also consider an Infiltration practice (3.9) as it is generally the more appropriate practice to treat sheet flow over a pervious surface. The Steering Committee will decide on a case-by-case basis whether a Dry Well or Infiltration practice is more appropriate to treat sheet flow over a pervious surface.

A. Criteria

- Practice should be located within 40 feet of downspout or impervious surface.
- The drainage area for a Dry Well must be <2,500 square feet of impervious cover. Runoff must be piped into the reservoir area.
- Dry Well shall be sized according to the following, where D is the depth of the reservoir (ft.) and Vr is Void Ratio of reservoir (typically 0.4 to 1.0). All practices detaining and/or infiltrating runoff must be sized to treat a 1 inch rainfall volume as per the DEQ Stormwater BMP Clearinghouse specifications.

Impervious Surface (sq. ft.) x 0.95/(12*Vr*D) = _____ sq. ft.

Pervious Surface (sq. ft.) x 0.25/(12*Vr*D) = _____ sq. ft.

Total Surface Area Size Required = _____ sq. ft.

- The footprint of the Dry Well may be reduced based on soil attributes and other site conditions, as approved by the District or certified by a licensed professional.
- The site must have soils capable of infiltrating stormwater runoff. Infiltration rate should be greater than 0.5 inches per hour. If the need for an underdrain is identified, the participant should consider a Bioretention practice (3.10).
- Dry Well should retain water for less than 48 hours after a storm event.
- Depth to Water Table and Bedrock shall be greater than 2 feet from bottom of excavation.
- Shall not be placed in wetland soil or within the 100-year flood plain.
- Shall not be appropriate where high pollutant or sediment loading is anticipated due to potential groundwater contamination and clogging.
- Shall not be appropriate where there is a significant risk for basement seepage or flooding, causes surficial flooding of groundwater, or interferes with the operation of drain fields or other subsurface structures.
- Dry Well depth is typically between 1 and 5 feet, with at least 12 inches of soil and sod cover.
- Gravel reservoir shall be wrapped in non-woven geotextile meeting NRCS specification Va-795.
- Leaf screens or debris sump shall be used as pretreatment to prevent clogging.
- Yard inlets may be used to collect and convey runoff to the Dry Well. The yard inlet must be properly maintained and include a debris sump and/or other pretreatment measure.
- Drip line gravel trenches may be used to collect and convey runoff to the Dry Well. The drip line gravel trench shall be installed as a gravel diaphragm (min. 1 foot deep, 2 feet wide) and function as the pretreatment measure for the Dry Well.
- Not intended to provide storage for large storms; therefore, a stable stormwater overflow or bypass route must be provided. Pop-up emitters are the preferred overflow device.
- All vegetated areas that drain to the practice must be maintained in full vegetative cover.
- Sodding must occur immediately after construction. Seasonal exceptions can be made
- Dry Well shall include observation ports or pop-up emitters for maintenance access.

B. Plans and Specifications

- A design plan for the site must be submitted by the applicant and approved by the Steering Committee before construction is initiated. The installed practice must be in accordance with the approved design unless changes were pre-approved by the Steering Committee. Information required in the planting/design plan includes (see VCAP Submission Checklist for a comprehensive list):
    - An infiltration test should be conducted to a minimum depth of 12 inches, and the infiltration test results must be submitted with the application.
    - Provide sizing calculations and pretreatment measures.
    - A statement regarding compliance with any permitting requirements or local codes

- Other information as requested by the local District.

C. Operation and Maintenance

- Maintenance inspections shall be conducted annually by the landowner, or a designated sub-contracted agent of the landowner.
- Maintenance will include:
  - Inspection of pretreatment devices and debris removal.
  - Inspection of observation ports for signs of prolonged standing water.
  - Routine maintenance of sod to ensure survival of vegetative cover.

D. Cost-Share Rates/Incentives

- See **District Reference Guide** for practice cost-share rates and caps.
- Eligible costs may include: excavation, grading/reseeding, stone, storage reservoir, piping, non-woven geotextile fabric, pre-treatment and overflow components, delivery of stone, seed/sod.

E. Helpful Technical References

- USDA NRCS Engineering Field Handbook Part 650 Chapter 14 Water Management (Drainage) subsection C Subsurface Drainage. 2001.
- Virginia Erosion and Sediment Control Handbook (VESCH) Specification 3.28 Subsurface Drains.
- Virginia Stormwater BMP Clearinghouse Design Specification No. 1 Disconnection and No. 8 Infiltration Practices.

Section 3.5 Constructed or Pocket Wetlands (CW)

A Constructed or Pocket Wetland can temporarily store, filter, and clean runoff from driveways, roofs and lawns and thereby improve water quality. To properly function in this regard, the wetland should be designed and constructed to retain water or remain saturated for two to three weeks.

Constructed Wetlands are typically less than 1 foot deep (although they have greater depths at the forebay and in micro pools) and possess variable micro topography to promote dense and diverse wetland cover. The wetland environment provides an ideal environment for gravitational settling, biological uptake, and microbial activity. Constructed Wetlands are the final element in a roof-to-stream runoff reduction sequence. They should only be considered for use after all other upland runoff reduction opportunities have been exhausted.

Policies Regarding CW

Constructed Wetlands are intended to meet the Level 1 baseline design criteria. Enhancements to a Level 2 design may be considered in accordance with the Clearinghouse guidelines. These are ideal for sites that cannot meet the Rain Garden or Dry Well practice standards. Consultation with the U.S. Army Corp of Engineers for the determination of jurisdictional wetlands is needed for poorly drained sites.

A. Criteria

- Project drainage area will not contain more than 0.5 acres at 25% impervious cover, unless the total project drainage area is less than 10,000 sq. ft. in which case impervious area will not be greater than 2,500 sq. ft.
- Constructed Wetlands must be excavated to the water table elevation to maintain a permanent base flow. Deep pools must be 24-48 inches deep. Micro-pools must be 12 inches deep or less. High marsh areas must be 6 inches deep or less.

- Constructed Wetlands must have at least three cells. Fifteen to twenty-five percent (15-25%) of the surface area must be deep pools (DP); fifty to seventy percent (50-70%) of the surface area must be high marsh (HM); and the remaining area may be micro pools (MP). All practices detaining and/or infiltrating runoff must be sized to treat a 1 inch rainfall volume as per the DEQ Stormwater BMP Clearinghouse specifications. Surface area may be calculated as follows:

  $D_{mean} = D_{DP}$ x (% deep pool) + D_{MP} x (% micro-pool) + D_{HM} x (% high-marsh)

  Impervious Surface (sq. ft.) x $0.95/(12D_{mean})$ = _____ sq. ft.

  Pervious Surface (sq. ft.) x $0.25/(12D_{mean})$ = _____ sq. ft.

  Total Wetland Area Required = _____ sq. ft.

- Variable width aquatic bench should be provided around any deep pools for safety. Width should be between 2 and 6 feet at a depth of 12 inches.
- A sediment forebay must be located at every concentrated inlet that receives 10% or more of the drainage area to provide energy dissipation and pretreatment. Forebays should be at least 15% of the surface area. Forebays are considered deep pools.
- The designer should provide for overland relief from the 10-year storm event. However, the maximum depth shall not exceed a foot above the high marsh during this storm event.
- Refer to the BMP Clearinghouse, Appendix E Landscaping for planting zones. A short list of plants which thrive in wetland planting zones are shown in Tables 13.3 and 13.4 of Virginia Stormwater BMP Clearinghouse Design Specification No. 13. Consult a professional horticulture specialist for additional plant choices.
- Plant selection for the project site must include some native Virginia species, but is not strictly limited to them. However, only native plants will be eligible to receive cost-share funds. Invasive or noxious species, as identified by the DCR invasive species list, and/or the USDA noxious weed list are prohibited. The Steering Committee reserves the right to deny applications and/or withhold cost-share payments from any projects that install invasive or noxious species.
- Required density and minimum ground covers for all plantings will be based on mature size of approved species within the approved site-specific plans. Suggested spacing: Plugs – 6 inches; perennials – 1 foot; grasses – 2 to 3 feet; small shrubs (< 6 feet tall) – 3 to 5 feet; large shrubs (> 6 feet tall) – 6 to 8 feet; small trees (<25 feet tall) – 25 feet; medium trees (<40 feet tall) – 30 feet; large trees (>40 feet tall) – 35 feet. See VDOF recommendations for tree saplings in the *Helpful Technical References* section.
- Only the minimum amount of fertilizer necessary to establish vegetation growth shall be utilized (according to soil test report).
- All material specification and construction details shall be in accordance with the Virginia Stormwater BMP Clearinghouse Specification No. 13.

B. Plans and Specifications

- A design plan for the site must be submitted by the applicant and approved by the Steering Committee before construction is initiated. The installed practice must be in accordance with the approved design unless changes were pre-approved by the Steering Committee. Information required in the plan includes (see VCAP Submission Checklist for a comprehensive list):
    - An infiltration test should be conducted to a minimum depth of 12 inches, and the infiltration test results must be submitted with the application.
    - Soil types and any required soil amendments as a result of a soil test, such as compost to add organic matter and improve soil structure and water holding capacity, or application of lime to increase pH of acid soils with the amounts, timing and method of application of each amendment.
    - Sizing calculations, list of plant species and planting density, pre-treatment measures. Plant list can include the common plant name but must include the scientific name. Vegetables, herbs, and annual plants are not allowed in the landscape plan.
    - An Erosion and Sediment Control Plan detailing full site stabilization.
    - A statement regarding compliance with any permitting requirements or local codes.
    - Other information as requested by the local District.

C. Operation and Maintenance

- Maintenance inspections shall be conducted annually by the participant, or a designated sub-contracted agent.
- Maintenance will follow guidelines on the Virginia Stormwater BMP Clearinghouse Design Specification No. 13.
- Sediment removal in the pools and forebays may be necessary every 3 to 5 years.
- Maintenance to include pretreatments, inlets/outlet, and vegetation.
- Applying fertilizer after vegetation has been established is prohibited as one of the purposes of VCAP is to reduce sources of nutrient pollution.

D. Cost-Share Rates/Incentives

- See **District Reference Guide** for practice cost-share rates and caps.
- Eligible costs may include: soil test, excavation, grading, soil amendments, installation costs (planting/seeding), impermeable liner, peat/clay amendments, plants, seed, mulch, pre-treatment costs.

E. Helpful Technical Resources

- Virginia Stormwater BMP Clearinghouse, Design Specification No. 13 Constructed Wetlands, Design Specification Appendix D, Design Specification Appendix E.

- Hunt, William F. and Bill Lord. 2006. Urban Waterways, Maintenance of Stormwater Wetlands and Wet Ponds. North Carolina Cooperative Extension Service. (Hunt and Lord, 2006).

Section 3.6 Vegetated Stormwater Conveyances (VSC)

Vegetated Stormwater Conveyances serve to prevent scour and erosion and provide water quality treatment while conveying stormwater. They are constructed trapezoidal channels lined with vegetation that inhibits erosion. From a water quality perspective, they are preferable to pipes because they allow more soil/water contact and more opportunity for infiltration. There are three types of vegetated conveyances: Dry Swales, Step Pool Conveyance, and Wet Swales.

Dry Swales (DS) are shallow channels with a series of check dams to provide temporary storage and to allow infiltration of the desired Treatment Volume (Tv). Dry Swales use an engineered soil media as the channel bed unless existing soils are permeable enough to infiltrate runoff into underlying soils. In most cases, however, the runoff treated by the soil media flows into an underdrain, which conveys treated runoff to a conveyance system downstream. The underdrain system consists of a perforated pipe within a gravel layer on the bottom of the swale, beneath the filter media. Dry Swales can be planted with turf grass or other suitable ground cover.

Wet Swales (WS) are shallow channels with check dams that create permanent pools that intercept groundwater and provide enhanced pollutant removal within the conveyance. The saturated soil and wetland vegetation provide an ideal environment for gravitational settling, biological uptake, and microbial activity. On-line or off-line cells are formed within the channel to create saturated soil or shallow standing water conditions.

Step Pool Conveyance Swales (SPCS) are defined channels that convert surface runoff to shallow groundwater through attenuation pools and sand seepage filters. These safely convey, attenuate, and treat stormwater with a series of constructed pools and riffles using engineered soil media.

SPCS can be designed to provide energy dissipation and extreme flood control, best suited to natural ravines with slopes of 10% or less.

Policies Regarding VSC

Vegetated Stormwater Conveyances shall not be used to modify or channelize existing drainage. All of these practices shall meet the Level 1 baseline design criteria. Dry and Wet Swales may be enhanced to a Level 2 design in accordance with the Clearinghouse guidelines. Step Pool Conveyance Swales shall only be considered after all other measures have been evaluated.

A. Criteria

- Maximum contributing drainage area should be 5 acres or less.
- Riprap lining and concrete hardening are not eligible activities.
- The practice shall not convey flows from an intermittent or perennial stream.
- The practice shall not discharge directly into a natural stream channel, and must be dispersed into a stable riparian buffer or vegetated filter strip. Design must ensure a stable, adequate outfall condition will exist. See Appendix A3.
- Should be designed with enough capacity to convey runoff from the 10-year design storm event within the channel banks and be non-erosive during the 10-year design storm events. See Appendix A1 and A3 for calculation procedures.
- Design must include at least 3 inches of freeboard at the top of the channel during the 10-year storm for conveyance draining a single lot. Conveyances draining more than one (1) lot or more than 1 acre shall provide a minimum of 6 inches of freeboard above the 10-year storm elevation to the foundation of adjacent structures.
- If turf reinforcement matting is used, it should be installed according to the manufacturer's recommendations. Manufactured products should have maximum permissible velocity specifications available.
- Required density and minimum ground covers for all plantings will be based on mature size of approved species within the approved site-specific plans. Suggested spacing: Plugs – 6 inches; perennials – 1 foot; grasses – 2 to 3 feet; small shrubs (< 6 feet tall) – 3 to 5 feet; large shrubs (> 6 feet tall) – 6 to 8 feet; small trees (<25 feet tall) – 25 feet; medium trees (<40 feet tall) – 30 feet; large trees (>40 feet tall) – 35 feet. See VDOF recommendations for tree saplings in the *Helpful Technical References* section.
- Plant selection for the project site must include some native Virginia species, but is not strictly limited to them. However, only native plants will be eligible to receive cost-share funds. Invasive or noxious species, as identified by the DCR invasive species list, and/or the USDA noxious weed list are prohibited. The Steering Committee reserves the right to deny applications and/or withhold cost-share payments from any projects that install invasive or noxious species.
- Only the minimum amount of fertilizer necessary to establish vegetation growth shall be utilized (according to soil test report).
- It must be verified that temporary and permanent channel linings are adequate for design flows. It is good practice to design conservatively by multiplying the calculated

velocity by a safety factor of 1.3.

- Channels should be designed with a trapezoidal or parabolic cross section. The bottom width of the channel shall be between 4 to 8 feet wide. A wider channel should incorporate benches, or a gravel diaphragm to prevent braiding and erosion.
- Each DS and WS must provide the required treatment volume within the temporary or permanent pool areas. See appendix A4 for calculation procedures.
- At least one check dam is required at the outfall of DS and WS and spaced according to the slope. Compacted earthen berm check dams are preferred. Pre-fabricated check dams, such as timber, metal, or concrete may be used where slope or length limitations exist.
- Adequate conveyance of stormwater into and out of the practice shall be in accordance with procedures outlined in Appendix A3 of this Manual.
- Dry Swale:
  - Sites must have soils capable of infiltrating. Ponded water should be retained no longer than 48 hours. Ensure that there are appropriate numbers of underdrain pipes and that they are adequately sized to meet this criteria.
  - Depth to water table or bedrock shall be greater than 2 feet.
  - The longitudinal slope of the channel should be less than 4%.
  - Temporary pool depth for the Treatment Volume shall be no more than 9 inches.
  - The side slopes should be no steeper than 3H:1V, flatter slopes are encouraged where adequate space is available.
  - All practices detaining and/or infiltrating runoff must be sized to treat a 1 inch rainfall volume as per the DEQ Stormwater BMP Clearinghouse specifications.
  - All material specification and construction details shall be in accordance with the Virginia Stormwater BMP Clearinghouse Specification No. 10.

- Wet Swale:
  - The longitudinal slope of the channel should be less than 2%.
  - Permanent pool depth for the Treatment Volume shall be no more than 6 inches.
  - Temporary ponding depth for the 10-year design storm shall not exceed 12 inches above the permanent pool elevation.
  - Works best in impermeable Hydrologic Soil Group C or D.
  - A landscaping plan is required for WS. See Constructed Wetland (CW) plant reference.
  - The side slopes should be no steeper than 4H:1V to enable wetland plant growth. Flatter slopes are encouraged where adequate space is available, to enhance pre-treatment of sheet flows entering the channel.
  - All practices detaining and/or infiltrating runoff must be sized to treat a 1 inch rainfall volume as per the DEQ Stormwater BMP Clearinghouse specifications.
  - All material specification and construction details shall be in accordance with the Virginia Stormwater BMP Clearinghouse Design Specification No. 11.

- Step-Pool Conveyance Swale:
  - The longitudinal slope of the channel should be less than 10 %. Steeper slopes may be considered when a substantial benefit can be quantified.
  - Riffles and pools shall not be more than 10 feet long.
  - Riffles shall have a depth of less than 12 inches. Pools should have a depth of 18 inches.
  - Boulder cascade shall have an elevation drop of 5 feet or less. Three pools separated by cobble riffles shall be used below a boulder cascade.
  - The width to depth ration (W/D) shall be greater than 2.
  - For other design specifications refer to Anne Arundel County, MD Step Pool Storm Conveyance Systems Design Guidelines and Calculator.

B. Plans and Specifications

- A design plan, with a professional seal, must be submitted by the applicant; or a waiver of liability may be accepted on a case-by-case basis (See Form 5). The installed practice must be in accordance with the approved design unless changes were pre-approved by the Steering Committee. Information required in the design plan includes (see VCAP Submission Checklist for a comprehensive list):
  - An infiltration test should be conducted to a minimum depth of 12 inches, and the infiltration test results must be submitted with the application.
  - Provide results of a soil assessment.
  - Provide adequate conveyance calculations.
  - Computations for Treatment Volume (Tv) in accordance with the applicable standards from the BMP Clearinghouse.
  - Landscape plan. Plant list can include the common plant name but must include the scientific name. Vegetables, herbs, and annual plants are not allowed in the landscape plan.
  - A suitable Erosion and Sediment Control Plan to stabilize the flow area.
  - A statement regarding compliance with any permitting requirements or local codes.
  - Other information as requested by the local District.
- Certification by a Licensed Professional may be required by the District to verify practice installation.

C. Operation and Maintenance

- Maintenance inspection shall be conducted annually by the landowner, or a designated sub-contracted agent of the landowner.
- Maintenance will follow guidelines on the Virginia Stormwater BMP Clearinghouse Design Specifications No. 10 and 11.
- Maintenance to include pretreatment, inlet/outlet, and check dams or grade control structures.

- Applying fertilizer after vegetation has been established is prohibited as one of the purposes of VCAP is to reduce sources of nutrient pollution.

D. Cost-Share Rates/Incentives

- See **District Reference Guide** for practice cost-share rates and caps.
- Eligible costs may include: excavation, grading, soil amendments, installation costs (planting/seeding), engineered soil, plant material (including live stakes and fascine cuttings), geotextile fabric, check dams, erosion and sediment controls (matting), riffle substrate, riprap/boulders, underdrain components, pretreatment costs.

H. Helpful Technical References

- Virginia Stormwater BMP Clearinghouse Design Specification No. 10 and 11.
- Virginia Erosion and Sediment Control Handbook, 3rd Edition.
- Regenerative Step Pool Storm Conveyance (SPSC) Design Guidelines. Anne Arundel County Maryland. December 2012.

Section 3.7 Rainwater Harvesting (RWH)

Rainwater Harvesting systems intercept, divert, store, and release rainfall for future use. Rainwater Harvesting includes the collection and conveyance into an above- or below-ground storage tank where it can later be used or directed to on-site stormwater practice for disposal/infiltration. Non-potable uses may include flushing of toilets and urinals inside buildings, landscape irrigation, exterior washing (e.g. car washes, building facades, sidewalks, street sweepers, fire trucks, etc.), fire suppression (sprinkler) systems, supply for chilled water cooling towers, replenishing and operation of landscaping water features and water fountains, and laundry, if approved by the local authority. Replenishing of pools may be acceptable if special measures are taken, as approved by the appropriate regulatory authority. Applicants should contact their local health department or other regulatory authority for required gray water permits.

Policies Regarding RWH

In many instances, Rainwater Harvesting can be combined with a secondary (down-gradient) runoff reduction practice to enhance runoff volume reduction rates and/or provide treatment of overflow from the Rainwater Harvesting system.

A. Criteria

- Cisterns must be at least 250 gallons.
- All practices detaining and/or infiltrating runoff must be sized to treat a 1 inch rainfall volume as per the DEQ Stormwater BMP Clearinghouse specifications. The eligible cistern volume will be determined using the following calculations:

Square footage of roof captured x 7.48/12 x 0.95 = _____ minimum gallons needed

*7.48 is a conversion factor from gallons to cubic feet

*0.95 is a runoff coefficient

- Water use plans shall outline the anticipated year-round water demand. Indoor usage shall include the flow rate of each fixture and appliance connected to the system and its anticipated weekly use in gallons. Irrigation rates vary by crops, typically 0.67 gallons should be applied per square foot per week. See Virginia Cooperative Extension Publications or local VCE agent.
- Cisterns must be placed in accordance with manufacturing instructions. Below ground cisterns must be installed below the frost depth (typically 2 feet). Above ground cisterns must have a stable foundation. Unless otherwise noted in the manufacturer's instructions, all cisterns shall be placed on a gravel bed or hardened pad at least 6 inches thick. Concrete foundations may be necessary according to the engineer.
- The cistern must have appropriate pretreatment measures to prevent debris from clogging the system or reducing the volume of storage. See Appendix B for examples.
- Above ground cisterns should have a height to width ratio of less than 2:1 whenever possible. An engineered design is required for cisterns over the 2:1 ratio.
- Local Building officials and Health Department officials should be consulted prior to installation of Rainwater Harvesting systems. All internal water uses and foundation designs must meet the applicable Health and Building Codes.
- Generally, winterization shall include disconnection of the downspout or following manufacturer guidelines for insulating spigots and pipes.
- Cistern overflow must be to a stable location. Adequate conveyance of stormwater overflow shall be in accordance with procedures outlined in Appendix A3 of this manual.
- All material specification and construction details shall be in accordance with Virginia Stormwater BMP Clearinghouse Design Specification No. 6.

B. Plans and Specifications

- A design plan, with a professional seal, must be submitted by the applicant; or a waiver of liability may be accepted on a case-by-case basis (See Form 5). The installed practice must be in accordance with the approved design unless changes were pre-approved by the Steering Committee. Information required in the plan includes (see VCAP Submission Checklist for a comprehensive list):
    - A basic Water Use Plan describing how and when water will be dispersed.
    - Foundation Design.
    - Winterization plan.
    - Cistern sizing calculations.
    - A statement regarding compliance with any permitting requirements or local codes.
    - Other information as requested by the local District.

- Certification by a Licensed Professional may be required by the District to verify practice installation.

C. Operation and Maintenance

- Maintenance inspections shall be conducted annually by the landowner, or a designated sub-contracted agent of the landowner.
- Maintenance will follow guidelines of the Virginia Stormwater BMP Clearinghouse Design Specification No. 6.
- Maintenance shall include gutters, downspouts, pretreatment, inlets, and outlets.

D. Cost-Share Rates/Incentives

- See **District Reference Guide** for practice cost-share rates and caps.
- Cost-share rate is applied to the 1 inch volume of runoff collected rounded up to the nearest gallon.
- Eligible costs may include: excavation, grading of pad, installation (placement, connection and stabilization), collection system (reasonable gutters/downspouts), pretreatment devices, cistern, stone/concrete for pad/bedding, overflow piping, elevated platform.

E. Helpful Technical References

- Virginia Rainwater Harvesting Manual. Cabell Brand Center. 2009.
- Virginia Stormwater Clearinghouse, Design Specification No. 6.
- Virginia Stormwater BMP Clearinghouse, Cistern Design MS-Excel Spreadsheet, v. 1.6. March 1, 2011.
- Virginia Department of Health. Virginia Rainwater Harvesting & Use Guidelines. 2011.
- Virginia Cooperative Extension. Summer Lawn Management: Watering the Lawn. Pub 430-010.
- Virginia Cooperative Extension. Irrigating the Home Garden. Pub 426-322.

Section 3.8 Bioretention (BR)

Bioretention as a practice is a shallow landscaped depression that temporarily ponds runoff 6 to 12 inches above the mulch layer and then filters through an engineered soil media prior to discharging to an underdrain or infiltrating into the underlying native soils. Bioretention practices typically treat parking lots, multiple lots and/or commercial rooftops. Inflow can be either sheet flow or concentrated flow. Bioretention should be located in common areas or within drainage easements, to treat a combination of roadway and lot runoff. Bioretention used on individual residential lots is commonly referred to as a *Rain Garden* and is covered in Section 3.4 above. In areas with space restrictions, *Urban Bioretention* may be utilized in the form of stormwater planters, expanded tree pits, or stormwater curb extensions, for example (Virginia Stormwater BMP Clearinghouse Design Specification No. 9, Appendix 9-A).

The primary component of the Bioretention practice is the engineered soil media, which has a mixture of sand, soil, and organic material as the filtering media and includes a surface layer of mulch. The underdrain consists of a perforated pipe in a gravel layer installed along the bottom of a filter bed.

Policies Regarding BR

Bioretention must have engineered soil media and often relies on an underdrain. A Level 1 Bioretention is considered a baseline design. This practice may be enhanced to a Level 2 design in accordance with Clearinghouse guidelines.

A. Criteria

- This BMP is intended to treat impervious surface areas greater than 2,500 square feet, and

with a contributing drainage area of less than 2 acres. All practices detaining and/or infiltrating runoff must be sized to treat a 1 inch rainfall volume as per the DEQ Stormwater BMP Clearinghouse specifications.

- Shall not be placed on wetland soils or in the 100 year flood plain.
- Depth to Water Table and Bedrock shall be greater than 2 feet from bottom of excavation.
- Sites must have soils capable of infiltrating. Ponded water should be retained no longer than 48 hours. Ensure that there are appropriate numbers of underdrain pipes and that they are adequately sized to meet this criteria.
- Only when the soil infiltration rate has been confirmed to be adequate and the Level 2 design criteria are met should underdrains be removed.
- Appropriate pretreatment practices for each inlet shall be provided. See appendix B.
- The designer should provide for relief from the storm event specified by local ordinances or for the 25-year storm event, whichever is the most stringent.
- Adequate conveyance of stormwater into and out of the practice shall be in accordance with procedures outlined in Appendix A3 of this manual.
- All material specifications and construction details shall be in accordance with Virginia Stormwater BMP Clearinghouse Design Specification No. 9.
- Landscaping shall include one (1) tree per 250 square feet of ponding area with a shrub to tree ratio of 3 to 1. Appropriate density of perennials shall be planted as in-fill.

B. Plans and Specifications

- A design plan with a professional seal must be submitted by the applicant; or a waiver of liability may be accepted on a case-by-case basis (see Form 5). The installed practice must be in accordance with the approved design unless changes were pre-approved by the Steering Committee. Information required in the planting/design plan includes (see VCAP Submission Checklist for a comprehensive list):
    - An infiltration test should be conducted to a minimum depth of 12 inches, and the infiltration test results must be submitted with the application.
    - Provide results of a soil assessment.
    - Provide sizing calculations.
    - Landscape planting and mulching plan including: species, rate of seeding or planting, minimum quality of planting stock and method of establishment. Only viable, high-quality seed or planting stock should be used. Plant list can include the common plant name but must include the scientific name. Vegetables, herbs, and annual plants are not allowed in the landscape plan.
    - Plant selection for the project site must include some native Virginia species, but is not strictly limited to them. However, only native plants will be eligible to receive cost-share funds. Invasive or noxious species, as identified by the DCR invasive species list, and/or the USDA noxious weed list are prohibited. The Steering Committee reserves the right to deny applications and/or withhold cost-share payments from any projects that install invasive or noxious species.

- Required density and minimum ground covers for all plantings will be based on mature size of approved species within the approved site-specific plans. Suggested spacing: Plugs – 6 inches; perennials – 1 foot; grasses – 2 to 3 feet; small shrubs (< 6 feet tall) – 3 to 5 feet; large shrubs (> 6 feet tall) – 6 to 8 feet; small trees (<25 feet tall) – 25 feet; medium trees (<40 feet tall) – 30 feet; large trees (>40 feet tall) – 35 feet. See VDOF recommendations for tree saplings in the *Helpful Technical References* section.
- Only the minimum amount of fertilizer necessary to establish vegetation growth shall be utilized (according to soil test report).
- A statement regarding compliance with any permitting requirements or local codes.
- Other information as requested by the local District.

- Certification by a Licensed Professional may be required by the District to verify practice installation.
- It is the VCAP participant's responsibility to ensure that any contractors meet all local codes and responsibilities.

C. Operation and Maintenance

- Maintenance will follow guidelines on the Virginia BMP Stormwater Clearinghouse, Design Specification No. 9.
- Maintenance inspections shall be conducted annually by the landowner, or a designated sub-contracted agent of the landowner.
- First year Maintenance will include:
  - Weekly watering during the growing season, as necessary to ensure survival.
  - Repair of erosion, as necessary.
  - Weed removal.
  - Removal of unwanted/invasive plant species.
- Sediment removal in the ponding and pretreatment areas may be necessary every 3 to 5 years.
- Supplement wood mulch to maintain a 3 inch layer, as needed.
- Maintenance shall include all components of the practice including inlets, pretreatments, outlets, and vegetative cover.
- Applying fertilizer after vegetation has been established is prohibited as one of the purposes of VCAP is to reduce sources of nutrient pollution.

D. Cost-Share Rates/Incentives

- See **District Reference Guide** for practice cost-share rates and caps.
- Eligible costs may include: excavation, grading, installation costs (backfill, planting/seeding), plant material, engineered soil media, stone, geotextile fabric, erosion and sediment control when necessary, mulch, pre-treatment costs, underdrain costs,

outlet/overflow structure.

E. Helpful Technical References

- Virginia BMP Stormwater Clearinghouse, Design Specification No. 9 Bioretention & Appendix 9A Urban Bioretention.
- Virginia Cooperative Extension. Urban Water-Quality Management: Rain Garden Plants. 2015. 426-043.
- Rain Garden Landscape Templates for the Mid-Atlantic.

Section 3.9 Infiltration (IF)

Infiltration is a practice that provides temporary surface and/or subsurface storage of stormwater runoff. Examples include gravel trenches or sodded areas over an underground gravel bed or storage chambers with or without an underdrain. Infiltration practices typically treat larger drainage areas such as parking lots, multiple lots, and/or commercial rooftops. Inflow can be either sheet flow or concentrated flow. Infiltration should be located in common areas or within drainage easements, to treat a combination of roadway and lot runoff. Infiltration used on individual residential lots is commonly referred to as a Dry Well and is covered in Section 3.4.

The primary component of the Infiltration practice is a high void media with either a gravel or reinforced storage chamber. The underdrain consists of a perforated pipe in a gravel layer installed along the bottom.

Policies Regarding IF

An Infiltration may or may not have an underdrain and may have surface ponding. A Level 1 Infiltration is considered a baseline design. This practice may be enhanced to a Level 2 design in accordance with Clearinghouse guidelines.

A. Criteria

- This BMP is intended to treat impervious surface areas greater than 2,500 square feet and with a contributing drainage area of less than 2 acres. All practices detaining and/or infiltrating runoff must be sized to treat a 1 inch rainfall volume as per the DEQ Stormwater BMP Clearinghouse specifications. Runoff to an Infiltration practice may be piped into the reservoir area or may discharge via overland flow.
- Shall not be placed on wetland soils or in the 100 year flood plain.
- Shall not be appropriate where high pollutant or sediment loading is anticipated due to

potential groundwater contamination and clogging.

- Shall not be appropriate where there is a significant risk for basement seepage or flooding, causes surficial flooding of groundwater, or interferes with the operation of drain fields or other subsurface structures.
- Depth to Water Table and Bedrock shall be greater than 2 feet from bottom of excavation.
- Sites must have subsoils capable of infiltrating. Ponded water should be retained for no longer than 36 to 48 hours.
- Observation wells are required for Infiltration trenches and maintenance ports are required for underground chamber systems.
- Underground bottomless or perforated chamber systems shall be designed to support the appropriate structural loads.
- Underdrains should only be included when the infiltration rates are less than 0.5 inches per hour or the drawdown time is greater than 48 hours. Ensure that there are appropriate numbers of underdrain pipes that are adequately sized to meet these criteria.
- Appropriate pretreatment practices for each inlet shall be provided, particularly when the practice treats sheet flow over a pervious surface. See appendix B.
- The designer should provide for relief from the storm event specified by local ordinance or for the 25-year storm event, whichever is the most stringent.
- Adequate conveyance of stormwater into and out of the practice shall be in accordance with procedures outlined in Appendix A3 of this manual.
- All material specifications and construction details shall be in accordance with Virginia Stormwater BMP Clearinghouse Design Specification No. 8.

B. Plans and Specifications

- A design plan with a professional seal must be submitted by the applicant; or a waiver of liability may be accepted on a case-by-case basis (see Form 5). The installed practice must be in accordance with the approved design unless changes were pre-approved by the Steering Committee. Information required in the design plan includes (see VCAP Submission Checklist for a comprehensive list):
    - An infiltration test should be conducted to a minimum depth of 12 inches, and the infiltration test results must be submitted with the application.
    - Provide results of a soil assessment.
    - Provide sizing calculations and design.
    - A statement regarding compliance with any permitting requirements or local codes.
    - Other information as requested by the local District.
- Certification by a Licensed Professional may be required by the District to verify practice installation.
- It is the participant's responsibility to ensure that any contractors meet all local codes and responsibilities.

C. Operation and Maintenance

- Maintenance will follow guidelines on the Virginia BMP Stormwater Clearinghouse, Design Specification No. 8.
- Maintenance inspections shall be conducted annually by the landowner, or a designated sub-contracted agent of the landowner.
- Maintenance shall include all components of the practice including inlets, pretreatments, outlets, and drainage areas.

D. Cost-Share Rates/Incentives

- See **District Reference Guide** for practice cost-share rates and caps.
- Eligible costs may include: excavation, grading, installation costs (backfilling), gravel, observation port, geotextile fabric, pre-treatment costs, outlet structures, erosion and sediment control when necessary.

E. Helpful Technical References

- Virginia BMP Stormwater Clearinghouse, Design Specification No. 8 Infiltration Practices.
- Virginia Erosion and Sediment Control Handbook, Standard and Specification 3.28.

Section 3.10 Permeable Pavement (PP)

Permeable Pavements are alternative paving surfaces that allow stormwater runoff to filter through voids in the pavement surface into an underlying stone reservoir, where it is temporarily stored and/or infiltrated. Traditionally paved surfaces are impermeable, converting rainfall to runoff. Permeable Pavement slows and captures rainwater, allowing it to infiltrate, promoting a high degree of runoff volume reduction and nutrient removal, and reducing the amount of impervious cover of a developed site. A variety of Permeable Pavement surfaces are available, including *pervious grid pavers, porous asphalt/concrete*, and permeable *interlocking pavers*. While the specific design may vary, all permeable pavement systems have a similar structure, consisting of a surface Permeable Pavement layer, an underlying stone aggregate reservoir layer, and a filter layer or fabric installed underneath.

Pervious Grid Pavers typically consist of a plastic or wire mesh grid filled with amended soil or sandy gravel on top of a 4 to 12 inch clean stone aggregate layer. These are typically used for low traffic areas.

Porous Asphalt and Concrete consist of a pavement mix with few fines that create pores in the surface. The asphalt/concrete is placed on top of a filter layer of clean pea gravel above a 12 to 24 inch clean stone aggregate reservoir.

Permeable Interlocking Pavers have pervious seams around the paver filled with sandy gravel or pea gravel. The pavers are placed on top of a filter layer of clean pea gravel above a 12 to 24 inch clean stone aggregate reservoir.

Policies Regarding PP

Permeable Pavement is typically designed with an underdrain and treats stormwater that falls on the actual pavement surface area, but it may also be used to accept run-off from small adjacent impervious areas, such as driving lanes or rooftops. This practice may be enhanced to a Level 2 design in accordance with Clearinghouse guidelines.

Permeable Pavement shall only be installed when it is either replacing impervious surface or treating additional impervious surface and when it is the most appropriate and cost-effective Best Management Practice to treat the resource concern.

A. Criteria

- The project area will not have a contributing drainage area greater than 0.5 acres. The contributing drainage area must be stabilized and ideally be as close to 100% impervious as possible. All practices detaining and/or infiltrating runoff must be sized to treat a 1 inch rainfall volume as per the DEQ Stormwater BMP Clearinghouse specifications.
- Depth to Water Table and Bedrock shall be greater than 2 feet from bottom of excavation.
- Only when the soil infiltration rate has been confirmed to be adequate and the Level 2 design criteria have been met can underdrains be removed.
- Shall not be appropriate where high pollutant or sediment loading is anticipated due to potential groundwater contamination and clogging.
- Shall not be appropriate where there is a significant risk for basement seepage or flooding, cause surficial flooding of groundwater, or interfere with the operation of drain fields or other subsurface structures.
- Shall not be installed on wetland soils or in the 100 year flood plain.
- The impact of freeze/thaw on the project must be evaluated. The reservoir layer and underdrain must be below the frost depth.
- The reservoir layer should not be hydraulically connected to the foundation of any structure.
- All material specification and construction details shall be in accordance with the manufacturers' recommendations and Virginia Stormwater BMP Clearinghouse Design Specification No. 7.

B. Plans and Specifications

- A design plan with a professional seal must be submitted by the applicant; or a waiver of liability may be accepted on a case-by-case basis (see Form 5). The installed practice must be in accordance with the manufacturer's specifications and approved design, unless changes were pre-approved by the Steering Committee. Information required in the plan includes (see VCAP Submission Checklist for a comprehensive list):
    - An infiltration test should be conducted to a minimum depth of 12 inches, and the infiltration test results must be submitted with the application.
    - Manufacturer's operation and maintenance manual or guidelines.
    - A statement regarding compliance with any permitting requirements or local codes.
    - Other information as requested by the local District.
- Certification by a Licensed Professional may be required by the District to verify practice installation.

C. Operation and Maintenance

- All operation and maintenance must follow manufacturer's recommendations. This may include sweeping coarse material, vacuuming fines (when needed), repairing/replacing damaged pavement areas, and cleaning out the pretreatment (if applicable).
- Maintenance inspections shall be conducted annually by the landowner, or a designated sub-contracted agent of the landowner.
- Maintenance will follow guidelines per the Clearinghouse Design Specification No. 7.
- Maintenance shall include all components of the practice including the surface material, observation well, underdrains, and drainage area.

D. Cost-Share Rates/Incentives

- See **District Reference Guide** for practice cost-share rates and caps.
- Eligible costs may include: excavation, grading, installation (backfilling, leveling), stone aggregate, pavers, grids, pervious concrete/asphalt, geotextile fabric, underdrain components, pretreatment when necessary, erosion and sediment controls when necessary.

E. Helpful Technical References

- Virginia Stormwater BMP Clearinghouse, Design Specification No. 7 Permeable Pavement.
- Ferguson, B.K., editor. 2005. Porous Pavements. Boca Raton, FL, CRC Press LLC.
- Smith, D.R. 2000. Permeable Interlocking Concrete Pavements: Selection, Construction, Maintenance, second edition. Washington, DC, Interlocking Concrete Pavement Institute.
- Smith, David R. 2006. Permeable Interlocking Concrete Pavement-Selection Design, Construction and Maintenance. Third Edition. Interlocking Concrete Pavement Institute.

Section 3.11 Green Roofs (GR)

Green Roofs or vegetated roofs are alternative roof surfaces that typically consist of waterproofing and drainage materials and an engineered growth media that is designed to support plant growth. Vegetated roofs capture and temporarily store stormwater runoff in the growth media. A portion of the captured stormwater evaporates or is taken up by plants, which helps reduce runoff volumes, peak runoff rates, and pollutant loads on development sites.

This standard is intended for situations where the primary design objective of the vegetated roof is stormwater management. Green Roof installations provide many other environmental benefits such as energy efficiency, air quality improvements, and habitat. There are two different types of vegetated roof systems: *intensive* vegetated roofs and *extensive* vegetated roofs. Intensive systems have a deeper growth media layer that ranges from 6 inches to 4 feet thick, which is planted with a wider variety of plants, including trees. By contrast, extensive systems typically have much shallower growing media (2 to 6 inches), which is planted with carefully selected drought tolerant vegetation.

Policies Regarding GR

This standard was developed for the installation of extensive green roof systems. Intensive systems in accordance with the Clearinghouse guidelines are eligible to apply but the incentive payment rate remains the same.

A. Criteria

- Roofs must be 200 square feet or larger. All practices detaining and/or infiltrating runoff must be sized to treat a 1 inch rainfall volume as per the DEQ Stormwater BMP Clearinghouse specifications.
- Plant establishment may be plugs/container; cuttings; seeding; vegetated mats; or modular/tray systems. Native species or mixes that are adapted to the site conditions and intended uses are encouraged. Selected species must have the capacity to achieve adequate density and vigor within an appropriate time frame. Establishment of vegetation generally takes 1 to 2 years.
- Plant selection for the project site must include some native Virginia species, but is not strictly limited to them. However, only native plants will be eligible to receive cost-share funds. Invasive or noxious species, as identified by the DCR invasive species list, and/or the USDA noxious weed list are prohibited. The Steering Committee reserves the right to deny applications and/or withhold cost-share payments from any projects that install invasive or noxious species.
- Species, density/rate of seeding or planting, minimum quality of planting stock and method of establishment shall be specified as part of the application. Only viable, high- quality seed or planting stock that is shallow-rooted, self-sustaining, and tolerant of direct sunlight, drought, wind, and frost should be used. Seeding or planting must be done at a time and in a manner that best ensures survival and growth of the selected species. The planting window extends from the spring to early fall, allowing plants to root thoroughly before the first killing frost. Green Roofs should not be planted in the winter. Temporary irrigation is often necessary during dry months as the roof is established.
- Only the minimum amount of fertilizer necessary to establish vegetation growth shall be utilized (according to soil test report).
- North and east aspects are preferred for survivability of vegetation and reduction of irrigation.
- Green roof designs shall include the following components:
  - Deck layer with adequate structural support
  - Insulation layer
  - Waterproofing layer
  - Drainage layer and system
  - Root barrier (non-woven geotextile fabric or similar)
  - Growth media
  - Plant cover
  - Slope stabilizer (if applicable)

- Roof pitch shall be a minimum of ¼":12" (2%) and no more than 4":12" (33%).
- Longest flow path from top of roof to gutter shall be less than 75 feet.
- Drainage layer shall be a minimum of 1 inch of pea gravel or a mat system.
- Growth media shall have less than 15% organic matter. Compost amendments must be free of detectable levels of pesticides and other hazardous chemicals.
- The participant is responsible for ensuring that the proposed installation and maintenance plan meets all applicable local policies and ordinances.
- Site constraints for construction and design should be identified (HVAC, electrical, roofing materials, pitch/slope, access and process for getting materials on the roof).
- Green Roof structural loads shall comply with Chapter 16 of the latest edition of the International Building Code.
- All material specification and construction details shall be in accordance with the manufacturers' recommendations and Virginia Stormwater BMP Clearinghouse Design Specification No. 5.

B. Plans and Specifications

- A design plan with a professional seal must be submitted by applicant; or a waiver of liability may be accepted on a case-by-case basis (see Form 5), and approval by the local Building Office if applicable. The installed practice must be in accordance with the approved design unless changes were pre-approved by the Steering Committee. Information required in the plan includes (see VCAP Submission Checklist for a comprehensive list):
  - Waterproofing specifications
  - Structural design specifications
  - Non-woven geotextile fabric specifications
  - Proposed growth medium depth and composition
  - Proposed vegetation and seeding/planting rate. Plant list can include the common plant name but must include the scientific name. Vegetables, herbs, and annual plants are not allowed in the landscape plan.
  - Drainage system specifications
  - Drainage and overflow system details
  - Irrigation considerations (permanent or temporary watering systems, hose bib connections, etc.)
  - A statement regarding compliance with any permitting requirements or local codes
  - Other information as requested by the local District
- Certification by a Licensed Professional may be required by the District to verify practice installation.

C. Operation and Maintenance

- Maintenance inspections shall be conducted a minimum of twice annually by the landowner, or a designated sub-contracted agent of the landowner.
- Maintenance will follow guidelines on the Virginia Stormwater BMP Clearinghouse Design Specification No. 5.
- Maintenance will include all components of the practice including vegetation, soil media, drainage system and structural integrity.
- Applying fertilizer after vegetation has been established is prohibited as one of the purposes of VCAP is to reduce sources of nutrient pollution.

D. Cost Share Rates/Incentives

- See **District Reference Guide** for practice cost-share rates and caps.
- Eligible costs may include: installation (placement of layers and planting), plant material, soil media, drainage system, additional structural support, root barrier material, waterproofing, insulation.

E. Helpful Technical References:

- Virginia Stormwater BMP Clearinghouse, Design Specification No. 5 Vegetated Roof.
- Dunnett, N. and N. Kingsbury. 2004. *Planting Green Roofs and Living Walls*. Timber Press. Portland, Oregon.
- Weiler, S. and K. Scholz-Barth 2009. *Green Roof Systems: A Guide to the Planning, Design, and Construction of Landscapes over Structure.* Wiley Press. New York, NY.
- 2015 International Building Code. July 2015. International Code Council, INC.
- The Green Roof Manual: A Professional Guide to Design, Installation, and Maintenance. By Edmund C. Snodgrass and Linda McIntyre. 2010.

Section 3.12 Living Shorelines (LS)

Living Shorelines is a shoreline management practice that provides erosion control and water quality benefits; protects, restores or enhances natural shoreline habitat; and maintains coastal processes through the strategic placement of plants, stone, sand fill and other structural and organic materials.

Living Shorelines encompasses a range of shoreline stabilization techniques along estuarine coasts, bays, sheltered coastlines and tributaries. A Living Shoreline incorporates vegetation and/or other soft elements alone or in combination with harder shoreline structures (e.g. oyster reefs or rock sills) for added stability. Living Shorelines maintain continuity of the natural land-water interface and reduce erosion while providing habitat value and enhancing coastal resilience.

Policies Regarding LS

Living Shorelines under this manual shall include marsh management techniques using vegetation. Marsh management refers to the enhancement of existing marshes, planting new marsh at existing grade, or planting new marsh on sand fill. It can also include riparian vegetation enhancement to improve adjacent wetland buffer and transition into upland area. Sills may be used where applicable when incorporated with vegetation. Breakwaters, bulkheads and revetments are not eligible for funding.

A. Criteria

- This practice should only be installed in areas with eroding shorelines as determined by a site evaluation and the maximum fetch at the project site does not exceed 1.5 miles in any shore angle direction.

- Applicants must obtain and comply with all applicable local, state, and federal permits, coordination with applicable agencies and specific design conditions. All applicants should attain a General Permit from the Virginia Marine Resource Commission (4VAC20-1300-10 et seq. or 4VAC20-1330-10 et seq.) A project must have a Virginia Marine Resources Commission (VMRC) permit to be considered a Living Shoreline practice; otherwise, it could be considered a Conservation Landscaping practice. Only projects with Group 1 permits will be eligible for cost-share under VCAP. Projects with Group 2 permits will not be eligible due to their size and scope being outside of VCAP's possible range.
- Sills shall always be combined with suitable wetland plantings. Sills should only be used in energy environments that warrant the additional protection beyond the marsh vegetation. Low energy environments may not warrant the use of sills or other structures. Sills shall always be constructed using materials acceptable for use in aquatic environments.
- Vegetation establishment must include proper slope preparation including bank grading and/or sand fill. Slope of sand fill shall be 10:1 or flatter. All sand used as fill shall be classified abiotic sand.
- Plant selection for the project site must include some native Virginia species, but is not strictly limited to them. However, only native plants will be eligible to receive cost-share funds. Invasive or noxious species, as identified by the DCR invasive species list, and/or the USDA noxious weed list are prohibited. The Steering Committee reserves the right to deny applications and/or withhold cost-share payments from any projects that install invasive or noxious species.
- Only the minimum amount of fertilizer necessary to establish vegetation growth shall be utilized (according to soil test report).
- Sills run parallel to the shoreline and shall be limited to a maximum length of 500 feet. Sills shall have at least one 5 foot opening, drop down, or overlap every 100 feet. Deviation from this drop down requirement shall be allowable through coordination with the local Wetland Boards, Virginia Marine Resource Commission, and National Marine Fisheries Service.
- Sill height shall not exceed 6 inches above the height of the adjacent wetland substrate. The side slope shall be no flatter than 2:1 (H:V) and the bottom width shall be no wider than 15 feet.
- For water bodies narrower than 150 feet, sills shall not encroach more than one sixth (1/6) the width of the water body. For all other shorelines, the landward edge shall be positioned no more than 30 feet water-ward of the existing mean low water line. The sill shall not be within a navigation channel marked or maintained by a state or federal agency. The sill shall not interfere with leases or franchises for shellfish culture.
- Appropriate wetland vegetation shall be planted in all wetland areas on which sand is placed where the resulting substrate elevation is appropriate to support the growth of wetland vegetation. Appropriate wetlands vegetation includes only those species listed in the tidal wetlands ordinance that are anticipated to survive at the project site elevation and normal salinity regime.
- This practice should be initiated as closely as possible to the optimum time for vegetation establishment. Within riparian areas, temporary conservation cover must be established

within 14 calendar days if permanent vegetation cannot be established.

- Design Criteria from a locality's Shoreline Management Plan and/or the Living Shoreline Design Guidelines for Shore Protection in Virginia's Estuarine Environments shall be referenced.

B. Plans and Specifications

- A design plan with proof of General Permit approval from the Virginia Marine Resource Commission (VMRC) must be submitted by the applicant. The installed practice must be in accordance with the approved design unless changes were pre-approved by the Steering Committee. Information required in the plan includes (see VCAP Submission Checklist for a comprehensive list):
  - Site Evaluation Checklist
  - Square footage of the area being planted and linear feet of shoreline being protected
  - Slope of the marsh fringe and upland bank
  - The mean high water (MHW) and low water (MLW) elevations must be clearly labeled with a measurement of the mean tide range. The tidal wetland-riparian transition elevation, and the upper limits of tidal wetland to be clearly labeled to include the high marsh zone above MHW.
  - Plan to control and/or eliminate unwanted existing vegetation
  - Landscape planting plan including: species, rate of seeding or planting, minimum quality of planting stock, time of year and method of establishment. Plant list can include the common plant name but must include the scientific name. Vegetables, herbs, and annual plants are not allowed in the landscape plan.
  - Post-construction inspection plan including frequency of inspections, responsible parties, and maintenance actions until planted vegetation is well-established.
- Certification by the permit-issuing authority may be required by the District to verify practice installation.
- It is the applicant's responsibility to ensure that any contractors meet all local codes and responsibilities.

C. Operation and Maintenance

- Maintenance of the planted area will be conducted annually by the landowner, or a designated sub-contracted agent of the landowner.
- Maintenance will include:
  - Annual survey of planted area to evaluate for invasive species and plant survival/success. New vegetation must maintain a cover of 90% or more. Maintain a photo log of vegetation growth. Replant denuded areas as necessary to ensure no net loss of wetland vegetation within the project area.
  - Spot treat invasive species to maintain density to less than 5% cover. Any measures taken to remove invasive species shall be conducted in accordance with a plan evaluated and approved by the appropriate wetlands board or

locality. Areas denuded must be re-vegetated with appropriate native wetlands vegetation. Trash and debris should be removed at least annually. This may include vegetative debris if it is adversely affecting the planted vegetation.

- Issues of trespass, leading to damaged vegetation, will be addressed as necessary.
- Structures such as sills shall be assessed for stability. Repair and replacement of failed sills in the same location shall be allowed without need of additional authorization. Additional sand may be placed to replace any lost sand or to adjust for substrate settlement, provided the elevation of the originally proposed grade is not exceeded.

- Applying fertilizer after vegetation has been established is prohibited as one of the purposes of VCAP is to reduce sources of nutrient pollution.

D. Cost Share Rates/Incentives

- See **District Reference Guide** for practice cost-share rates and caps.
- Eligible costs may include: excavation, grading, installation (fill, planting/seeding), sand fill, fiber logs, shell bags, riprap, woven containment bags, plant material (including live stakes or fascine cuttings)

E. Helpful Technical References

- Living Shoreline Design Guidelines for Shore Protection in Virginia's Estuarine Environments. VIMS Shoreline Studies Program. 2010.
- Virginia Institute of Marine Science, Shoreline Studies Program.
- Virginia Institute of Marine Science, Center for Coastal Resources Management Comprehensive Coastal Resource Management Portals for local governments.
- Department of Conservation and Recreation. Shoreline Erosion Advisory Service.

General References

- Alliance for the Chesapeake Bay. Chesapeake Riverwise Communities.
- Bedient, P.B. and Huber, W.C. Hydrology and Floodplain Analysis. 2nd edition. Addison-Wesley. 1992.
- Chesapeake Bay Program Water Quality Goal Implementation Team, 2010. Protocol for the Development, Review, and Approval of Loading and Effectiveness Estimates for Nutrient and Sediment Controls in the Chesapeake Bay Watershed Model.
- Chesapeake Bay Program Water Quality Goal Implementation Team, 2012. Recommendations of the Expert Panel to Define Removal Rates for Urban Stormwater Retrofit Projects.
- Chesapeake Stormwater Network. Homeowner Guide for a more Bay-Friendly Property. 2014.
- Chesapeake Stormwater Network. Technical Bulletin 9. Nutrient Accounting Methods to Document Local Stormwater Load Reductions in the Chesapeake Bay Watershed. August 15, 2011.
- Claytor, R.A., and T.R. Schueler. (1996) Design of Stormwater Filtering Systems. Prepared by the Center for Watershed Protection, Ellicott City, MD, for the Chesapeake Research Consortium, Solomons, MD, and USEPA, Region V, Chicago, IL.
- Virginia Department of Conservation and Recreation. Riparian Buffers Modification & Mitigation Guidance Manual 2006.
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- Virginia Erosion and Sediment Control Handbook. Third Edition. Commonwealth of Virginia Department of Conservation and Recreation. 1992.
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- Soil Quality Test Kit Guide. USDA. ARS. NRCS. Soil Quality Institute. 2001.
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- Richardson, J.L., and M.J. Vepraskas, eds. 2001. Wetland Soils: Genesis, Hydrology, Landscapes, and Classification. Boca Raton, FL: CRC Press LLC.
- Rappahannock River Basin Commission. 2012. Rappahannock River Friendly Yard Brochure, July 2012.
- Schueler, T.R., and H.K. Holland, eds. 2000. The Practice of Watershed Protection. Ellicott City, MD: Center for Watershed Protection.

- Schueler, T. 1987. Controlling Urban Runoff – A Practical Manual for Planning and Designing Urban Best Management Practices. Metropolitan Washington Council of Governments. Washington, DC 240 pp.
- UVA Today. 2012. U.Va. Researchers: Virginia's Growth Outpaces Nation's.
- United States Environmental Protection Agency Chesapeake Bay Program. 2010. Chesapeake Bay Phase 5 Community Watershed Model. Section 6. Best Management Practices for Nutrients and Sediments.
- Vepraskas, M.J. 1999. Redoximorphic Features for Identifying Aquic Conditions. Tech. Bull. 301. NC Agric. Exp. Stn., Raleigh, NC.

Laws and Regulations Pertaining to Stormwater Management in the Commonwealth of Virginia:

- Commonwealth of Virginia Erosion and Sediment Control Act. Code of Virginia Title 62.1 Chapter 3.1 Article 2.3 Section 44.15:51 seq.
- Virginia Erosion and Sediment Control Regulations. Virginia Administrative Code Title 9 Agency 25 Chapter 840
- Commonwealth of Virginia Stormwater Management Act. Code of Virginia Title 62.1 Chapter 3.1 Article 2.3 Section 44.15:24 seq.
- Virginia Stormwater Management Program Regulations. Virginia Administrative Code Title 9 Agency 25 Chapter 870
- General VPDES Permit for Discharges of Stormwater from Small Municipal Separate Storm Sewer Systems (MS4s). Virginia Administrative Code Title 9 Agency 25 Chapter 890.

Appendix A – Calculations

A.1 Practice Sizing

Treatment Volume is used to meet the performance criteria for selected types of stormwater BMPs such as runoff reduction and pollutant removal practices. These stormwater BMPs must have adequate treatment volume for the removal of pollutant loads as defined by the Virginia BMP clearinghouse. The size of the practice is a function of the treatment volume (Tv); Storage Depth (D); and Surface Area (SA).

Each structural practice submitted for funding should be sized on the equations below.

Calculate Treatment Volume

Tv = Rv * CDA * (P/12)

Tv = Volume of runoff (ft^3)

Rv = Runoff Coefficient (fraction of rainfall that will produce runoff) , see table A1.1.

CDA = Contributing Drainage Area that drains to BMP (ft^2)

P = Depth of rainfall treated (inches) (Typ. 1 inch)

Table A1.1: Rv Coefficients

Land Cover	HSG A Soils	HSG B Soils	HSG C Soils	HSG D Soils
Forest/Unmanaged Lands	0.02	0.03	0.04	0.05
Managed Turf	0.15	0.20	0.22	0.25
Impervious Cover	0.95	0.95	0.95	0.95

Runoff Storage Depth of the Practice

Ds = Ponding Depth + Soil Depth x porosity + Gravel Depth x porosity

Porosity of various layers: soil = 0.25; gravel = 0.4; surface = 1.0

Surface Area of the Practice

SA = Tv / Ds

Surface Area and Storage Depth can be calculated interchangeably based on site specific constraints such as available footprint and utility conflicts.

Permeable Paver Sizing Example:

Impervious Area Tv = 0.95/12 * 2,000 = 158 cubic feet

Pervious Area Tv = 0.22/12 * 5,000 = 833 cubic feet

Total Tv = 158 + 833 = 991 cubic feet

Ds = 1 * 0.4 = 0.4

SA = 991/0.4 = 2,478 sq. ft. of pavers with a 1-ft reservoir layer.

If there is only 1,000 square feet available; Ds = 991/1,000 = 0.99 and gravel depth = 0.99/0.4 = 2.5 ft.

A.2 **Determining Peak Flow**

The peak flow is used to determine the proper size of stormwater conveyance systems such as inlets, culvert and open channels and is also used to determine the proper size of outlet devices. Peak flow can be calculated easily using the "Rational Method" (Bedient and Huber, 1992) for small impervious drainage areas. Larger drainage areas with a variety of vegetative cover and soil types should use the NRCS curve number method. For details on the Curve Number method see section 4 - 4.3 of the Virginia Stormwater Management Handbook Volume 2 first edition 1999.

Rational Method:

The rational method is a simple model used to estimate the peak flow from a given watershed using a simple formula. For applications such as backyard stormwater BMPs, where small, highly impervious watersheds will be treated, the rational method offers a somewhat coarse, but adequate, estimate of peak flow. The rational formula estimates the peak rate of runoff at any location in a drainage area as a function of the runoff coefficient, rainfall intensity and drainage area. Runoff coefficient, C, represents the condition of the land within the drainage area and is based on land use, soil type and slope (See Table 4.5 of the 1999 VSWMH). Rainfall intensity, I, is the average rainfall rate (inches per hour) for a storm duration equal to the time of concentration (Tc) for a selected design storm event (2-year, 10-year, etc.). The drainage area, A, is the contributing area that is being treated by the BMP.

The rational method formula is as follows: $q = Rv\ I\ A$

q = Peak flow (ft^3/s)

Rv = Runoff Coefficient (dimensionless), see table A1.1 of this manual

A = Watershed area being treated (acres)

I = Rainfall Intensity of Storm Event (inches/hour), use the site-specific 5-minute 10-year rainfall intensity.

For more pervious drainage areas over 1 acre, use the site-specific 10-minute 10-year rainfall intensity.

(Note: There are 43,560 square feet in 1 acre)

Peak Flow Example:

I = 5-minute 10-year Intensity for Culpeper County = 6.68 inches per hour

Impervious Area q10 = 0.95*2,000/43,560*6.68 = 0.291 cfs

Pervious Area q10 = 0.22*5,000/43,560*6.68 = 0.168 cfs

Total q10 = 0.291 + 0.168 = 0.46 cfs

A.3 **Outlet Sizing**

Orifice Outlet:

Particular BMPs may have a hydraulic depth (i.e. head) of ponding sufficient to allow a pipe outlet. These BMPs will be designing a barrel outlet based on the orifice equation.

$q = C\ a\ \sqrt{(2gh)}$

Where q = design flow rate (cfs)

C = orifice coefficient (typ. 0.6)

a = area of orifice (sq. ft.)

g = gravitational acceleration, 32.2 ft./ sec^2

h = head or depth of dry storage (ft.)

To size the barrel orifice, rearrange the equation and solve the area of orifice. $a = q / (C\sqrt{(2gh)})$ Then use the following equation: $D = \sqrt{(4\ a / \prod)}$

Overflow Weirs:

Weir outlets should be sized so that the berm is not overtopped during a 10-year storm event. This means that the weir notch must be long enough to allow the peak flow associated with the 10-year storm to pass without the water rising high enough that the top of the berm is reached. To determine the appropriate length of weir notch to pass the 10-year storm, the weir equation can be applied.

$q = C_w\ L\ H^{1.5}$

Where:

q = Flow (ft^3/s)

C_w = Weir Coefficient (dimensionless)

L = Length of Weir (feet)

H = Height of Water over Top of Weir (feet)

The peak flow rate passed by the weir is the flow associated with the 10-year event (see appendix A2). The weir coefficient is set to 2.7 for a vegetated broad weir or 3.3 for a drop inlet. The 10-year depth, H should be no higher than 2 inches (0.17 feet) for a vegetated weir so the water will not flow over the containment berm. Thus, the only unknown in the equation is the length of the weir. This equation can be rearranged to solve for the weir length, as follows:

$L = q \div (C_w\ H^{1.5})$

Weir and Orifice Example:

Weir head, H = 0.1 ft. Orifice head, h = 0.5 ft. q10 = 0.46 cfs

L = 0.46 / (2.7(0.1^1.5)) = 5.4 ft. → use 6 ft.

a = 0.46/(0.6√(2*32.2*0.5)) = 0.135 sq. ft. D = √(4*0.135/∏) = 0.41 ft. = 5 inches

A.4 **Adequate Conveyance of Stormwater**

The Manning's Equation and the Continuity equation below are used to calculate the velocity and flow rate capacity of downstream channel or pipe system. All structural practices are expected to discharge stormwater into an adequate stormwater conveyance system. After the peak flows are computed and the outlets sized, the designer should check that the practice discharges at an adequate velocity that is less than the permissible velocity of the channel materials and to verify that the conveyance has adequate capacity to handle the overflow.

The receiving stormwater conveyance system shall have adequate capacity to handle the 10-year peak flow and resist erosion during the 10-year peak flow.

Overland relief may be sheet flow, if the 10-year peak flow depth is less than half the height of the receiving vegetation and the 10-year flow velocity should be less than 1 foot per second.

Manning's Equation:

$V = 1.49 / n\ S^{1/2}\ R^{2/3}$

Where: V = Velocity, ft./sec

n = Mannings Roughness Coefficient

S = Slope, ft./ft.

R, Hydraulic Radius (ft.) = CSA / P_w

CSA = Cross Section Area, sq. ft.

P_w = wetted perimeter of channel, ft.

Continuity Equation:

Q = V (CSA)

Where: Q = Flow Rate, cfs

See Table 5-7 in the 1992 VESCH for roughness coefficients for sheet flow.

Use the roughness coefficient modifying tables for Chanel roughness. See table 5-16 to 5-21 in the 1992 VESCH.

Use Table 5-14 and 5-22 with Plate 5-39 in the 1992 VESCH for permissible velocities.

A.5 **Determining Pollutant Load**

The state of Virginia has accepted the Simple Method procedure for determining pollutant loads from developed sites. A more detailed discussion and derivation of the Simple Method (Schueler, 1987). The Simple Method uses impervious cover as the key variable in calculating the levels of pollutant transported. The Simple Method is an easy technique that is used to calculate the Treatment Volume for a given stormwater treatment practice. The technique requires a modest amount of information including: (1) area that will be draining to the proposed BMP location in acres, (2) the percentage of the drainage area that is impervious, (3) annual regional rainfall, and (4) pollutant concentration.

Simple Method General Pollutant Load Equation for chemical constituents:

$L = 0.226 \times R \times C \times A$

L = relative total pollutant load (lbs/year) R = Annual Runoff (inches)

C = Pollutant Concentration (see table A1)

A = drainage area treated by stormwater treatment practice (acres)

Note: 0.226 is a conversion factor

Simple Method General Pollutant Load Equation for Bacteria:

$L = 103 \times R \times C \times A$

L = relative annual load of bacteria (billions of colonies) R = Annual Runoff (inches)

C = Pollutant Concentration (see table A1)

A = drainage area treated by stormwater treatment practice (acres)

Note: 103 is a conversion factor

Calculate Annual Runoff

$R = P \times P_j \times Rv$

P = average annual rainfall (inches), usually 43 inches*

P_j = unit less correction factor for storms with no runoff = 0.9

Rv = unit less Runoff coefficient

Note: * indicates the annual rainfall may vary across the state of Virginia based on locally collected rainfall data.

Calculate Runoff Coefficient

$Rv = 0.05 + (0.009 * I)$

Rv = Runoff Coefficient (fraction of rainfall that will produce runoff) I = Connected impervious percentage in watershed (%)

Table A5.1: National Median Concentrations for Chemical Constituents in Stormwater

Constituent	Units	Urban Runoff
TSS	mg / l	54.5[1]
TP	mg / l	0.26[1]
TN	mg / l	2.00[1]
Cu	ug / l	11.1[1]
Pb	ug / l	50.7[1]
Zn	ug / l	129[1]
E. Coli	1,000 col / ml	1.5[2]

Source: [1]Pooled NURP/USGS (Smullen and Cave, 1998), [2] Schueler (1999)

Pollutant Load Removed by Stormwater BMP

$L_{removed}$ = L x EFF

$L_{removed}$ = relative pollutant load removed from stormwater (lbs/year) L = pollutant load treated by stormwater BMP

EFF = pollutant removal efficiency of stormwater BMP

Pollutant Load Example:

Impervious Load =0.226*(43*0.9*0.95)*0.26*2,000/43,560 = 0.0992 lb. P per year

Pervious Load = 0.226*(43*0.9*0.22)*0.26*5,000/43,560 =0.0574 lb. P per year

Total Pollutant Load = 0.0992 + 0.0574 = 0.157 lb. P per year

Permeable Pavers Pollutant Removal rate, EFF = 59 %

Pollutant Load Removed, Lremoved = 0.157 * 0.59 = 0.0926 lb. P per year

Rain Garden Pollutant Removal Rate, EFF = 55%
Pollutant Load Removed, Lremoved = 0.157 * 0.55 = 0.0864 lb. P per year

Appendix B – Pretreatment Requirements for VCAP BMPs

General Guidance:

Pretreatment is a necessary component of many stormwater BMPs. Pretreatment techniques protect a BMP from the buildup of trash, sediments and particulate matter; and dissipate erosive velocities entering the practice (MPCA, 2008). If a particular stormwater BMP is sensitive to heavy loadings of fine sediments; or if there is a "hotspot" site which will produce high sediment and pollutant loads, then pretreatment is required.

There are three types of pretreatment: dissipaters, settling devices, and screens or filters. Settling devices and dissipaters are usually at the transition point into the BMP, whereas screens and filters may be incorporated into the stormwater conveyance system. When multiple pretreatment measures are required, the treatment train should include dissipaters to settling device to screen/filter device. For gutters and downspouts, screen or filter devices may be used prior to dissipater and settling devices.

Table B.1: Typical Pretreatment Measures by Practice

Practice	Typical Pretreatment		
	Dissipating	Settling	Screens/Filters
Conservation Landscaping	NA	Grass Filter Strip	
Rain Garden	Gravel Diaphragm	Grass Channel	Downspout Devices
Dry Well	NA	Sump Basins	Downspout Devices
Constructed Wetland	Gravel Diaphragm	Sediment Forebay; Grass Channel	Downspout Devices
Rainwater Harvesting	NA	Downspout Devices	
Vegetated Stormwater Conveyance; Bioretention; Infiltration	Gravel Flow Spreader; Gravel Diaphragm	Sediment Forebay; Engineered Level Spreader; Sump Basins	Grass Filter Strip; Propriety Devices
Permeable Pavement	NA	Gravel Diaphragm	Downspout Devices

Specific Pretreatment Requirements:

1. For stormwater BMPs requiring pretreatment, the selected pretreatment measures must be provided above and outside of the treatment area. Pretreatment may store up to 10 percent of the Treatment Volume per inlet.
2. Only inlets contributing more than 20% of the drainage area need a pretreatment measure.
3. The type of flow (i.e. Sheet Flow versus Concentrated Flow) determines the appropriate pretreatment device. The primary function (i.e. dissipater, settling, or screen/filter) of the pretreatment device should also be considered.
4. Impervious Surface Removal; Green Roofs; and Living Shorelines do not require pretreatment devices. Conservation Landscaping will not need pretreatment unless

there is a risk of damage from the contributing drainage area.

The following technical guidance for pretreatment measures can also be found in the Virginia Stormwater Management Handbook, first edition and Virginia Stormwater BMP Clearinghouse.

Grass Filter Strip

When runoff is sheet flow from such areas as parking lots, residential yards, etc., a grass filter strip, often enhanced with a gravel diaphragm, is usually employed (Va. SWMH 1999). Table B.2 provides sizing guidelines as a function of inflow approach length, land use, and slope.

Design Criteria:

- The grass filter width shall be the width of the practice.
- The minimum filter strip length should be 10 feet.
- The contributing drainage area should not have more than 5,000 square feet of impervious surface.
- Use a gravel diaphragm when impervious surface exceeds this limit or when the minimum filter length cannot be met.

Construction Criteria:

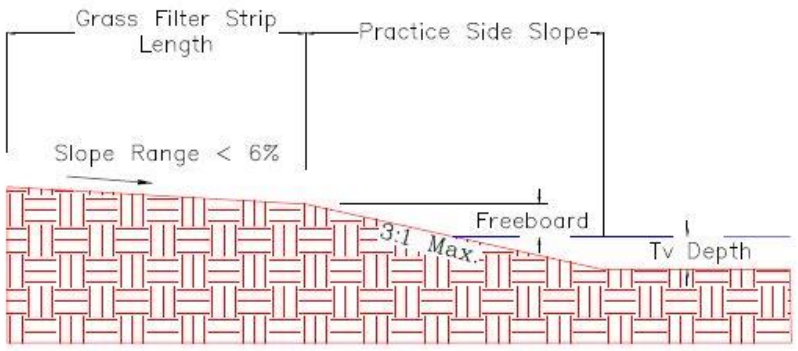
- Avoid compaction of the filter strip.
- Surface rough and/or apply stabilization matting.
- Amend the soil of the filter strip with compost and lime and fertilizer as needed.

Maintenance:

- Mow height 6 inches plus
- Maintain a 90 % vegetative cover
- Periodic removal of sediments and debris
- Monitor to prevent development of rills and gullies.

Table B.2: Pretreatment Filter Strip Sizing Guidance (Source: Claytor and Schueler, 1996)

Parameter	Impervious Parking Lot*				Residential Lawns				Notes
Maximum Inflow Approach Length (Feet)	35		75		75		150		
Filter Strip Slope	< 2 %	>2%	<2%	>2%	<2%	>2%	<2%	>2%	Max = 6%
Minimum Length	10ft.	15ft.	20ft.	25ft.	10ft.	12ft.	15ft.	18ft.	*GD as necessar



Gravel Diaphragm

A gravel diaphragm at the top of the slope is created by excavating a 2-foot wide and 1-foot deep trench that runs on the same contour at the top of the filter strip or grass channel. The diaphragm is filled with clean pea gravel (D50: 3/8" to ½"). The diaphragm serves two purposes. First, it acts as a pretreatment device, settling out sediment particles before they reach the practice. Second, it acts as a level spreader, maintaining sheet flow. (Virginia Clearinghouse 2009 Specs)

Design Criteria:

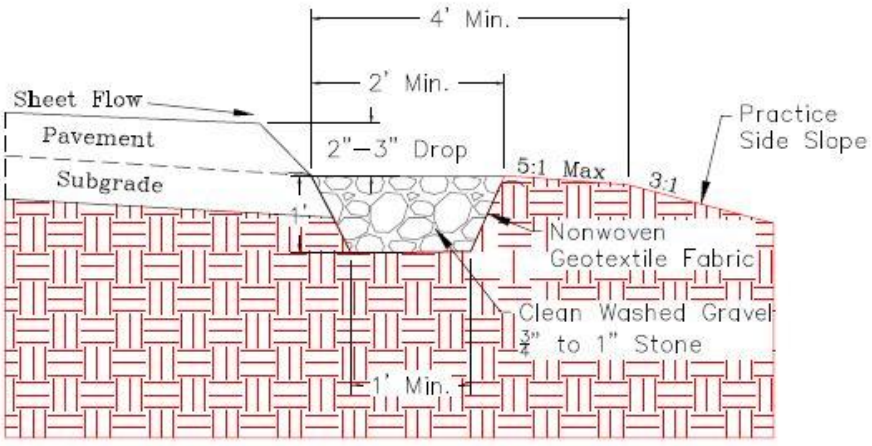
- Maximum flow length from impervious surfaces shall be 75 feet.
- The flow should travel over the impervious area and to the practice as sheet flow and then drop at least 2-4 inches onto the gravel diaphragm. The drop helps to prevent runoff from running laterally along the pavement edge, where grit and debris tend to build up.
- A layer of nonwoven filter fabric should be placed between the clean gravel and the underlying soil trench.
- If the contributing drainage area has a slope greater than 2%, then larger clean gravel (D50: ½"-2") and/or a wider trench should be used in the diaphragm.

Construction Criteria:

- Scarify bottom of trench.
- Line with woven geotextile fabric against the pavement and bottom.
- Maintain a trench cross slope of 0%.

Maintenance:

- Periodic removal of sediments and debris
- Monitor to prevent development of rills and gullies.



CROSS SECTION

Grass Channel

For applications where concentrated runoff enters the practice by surface flow, such as through a slotted curb opening, a grassed channel, often equipped with a gravel diaphragm to slow the velocity and spread out the flow entering the basin, is the usual pretreatment method. (Va. SWMH 1999) The length of the grassed channel depends on the drainage area, land use, and channel slope. Table B.3 provides recommendations on sizing for grass channels leading into a practice for a one acre drainage area.

Design Criteria:

- The minimum grassed channel length should be 20 feet.
- Cross sectional dimensions of the grass channel shall ensure that the velocity from a storm intensity of 1 inch per hour is 1 foot per second or less. Typical bottom width between 2 and 6 feet and depth of flow should be less than 3 inches (VA. SWMH 1999).
- Use a gravel diaphragm when the minimum length cannot be met, placed at the end of the channel. Use a gravel diaphragm when the channel bottom width exceeds 4 feet placed in the middle.
- Verify channel capacity meets the 10-year peak flow for velocity and maximum depth.
- Use Check Dams when channel slope exceed 2 percent; or when erosive flows occur for the 10-year storm. Space check dams 25 feet apart starting at the practice and working uphill.

Construction Criteria:

- Apply stabilization matting on the bottom and side slopes.
- Amend soil with compost and lime and fertilize as needed.
- Construct during dry weather whenever possible.
- Use temporary checks as needed.

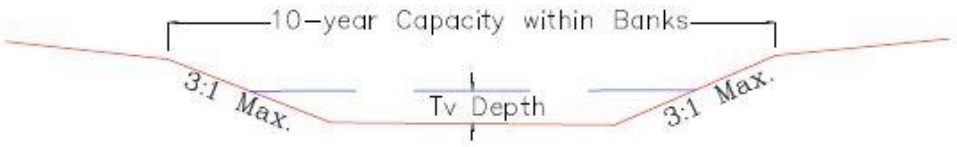
Maintenance:

- Mow height 6 inches plus
- Maintain a 90 % vegetative cover

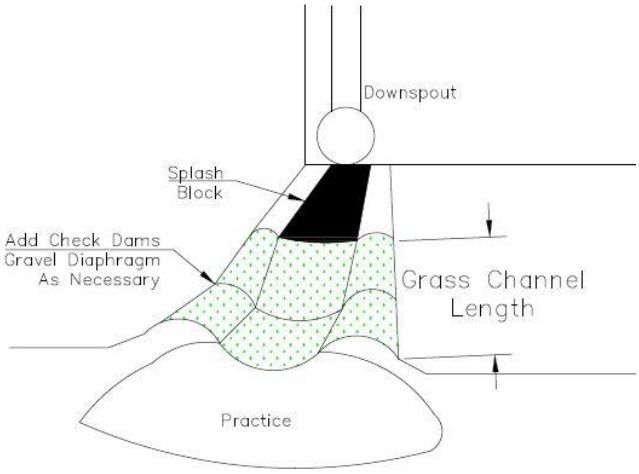
- Periodic removal of sediments and debris
- Monitor to prevent development of rills and gullies.

Table B.3: Pretreatment Grass Channel Sizing Guidance for a 1.0 Acre Drainage Area (Source: Claytor and Schueler, 1996)

Parameter	< 33 % Impervious		Between 34 % and 66 % Impervious		>66 % Impervious		Notes
Slope	<2%	>2%	<2%	>2%	<2%	>2%	Max. = 4%
Minimum Length (feet)	25	40	30	45	35	50	Multiple by CDA acreage



CROSS SECTION



ISOMETRIC DETAIL

Engineered Level Spreader with Forebay

An engineered level spreader is an energy dissipater device that is used to convert concentrated stormwater runoff to sheet flow. The engineered level spreader should be located at each point of concentrated incoming flow of the stormwater BMP. Spreader may be perpendicular for pipe flows and parallel for channel flow.

Design Criteria:

- The width of the level spreader lip shall be sized to disperse the 10-year peak flow as sheet flow with a flow depth less than ½ the height of the receiving vegetation, typically 0.1 to 0.17 feet. Level Spreader width should not exceed the width of the practice.
- Design flows less than 10 cfs, the length of the scour pool should be at least 7 feet and

the depth should be 6 inches. Design flows greater than 10 cfs, the length of the scour pool should be at least 10 feet and the depth should be 12 inches.

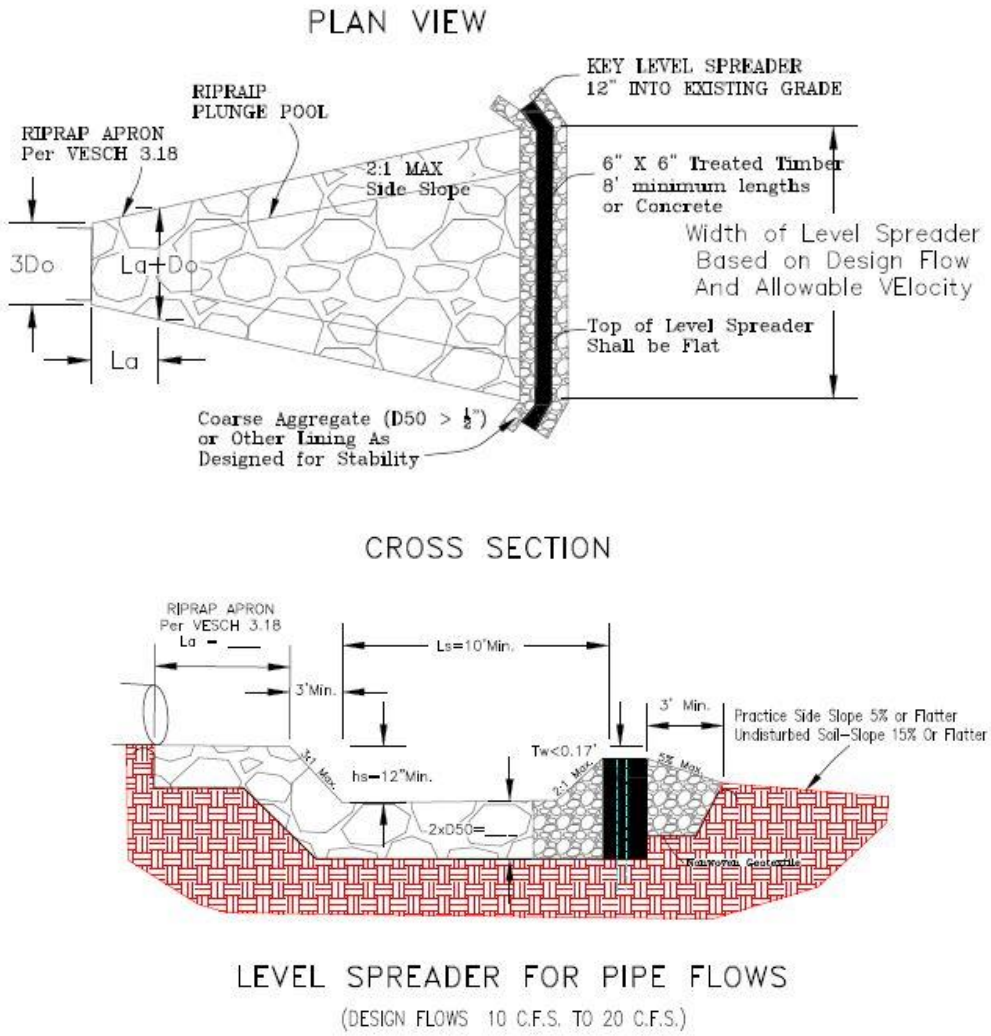
- The area below the level spreader should be flat with no more than a 5 percent slope entering the practice.

Construction Criteria:

- Ends of the level spreader tied into the slope to avoid flanking.
- Downstream receiving slope may need stabilization matting.
- Grade of channel for the last 20 feet shall be less than 1%. Spreader grade shall be 0%.
- Not to be installed on or above fill material.

Maintenance:

- Periodic removal of sediments and debris.
- Monitor to prevent development of scouring in, around and downslope of spreader.



LEVEL SPREADER FOR PIPE FLOWS

(DESIGN FLOWS 10 C.F.S. TO 20 C.F.S.)

Gravel Flow Spreader

Gravel flow spreaders are energy dissipaters that are located at curb cuts or at channel transitions down steep side slopes. These flow spreaders combine riprap slope protection with an outlet protection apron that incorporates a gravel diaphragm to disperse runoff.

Design Criteria:

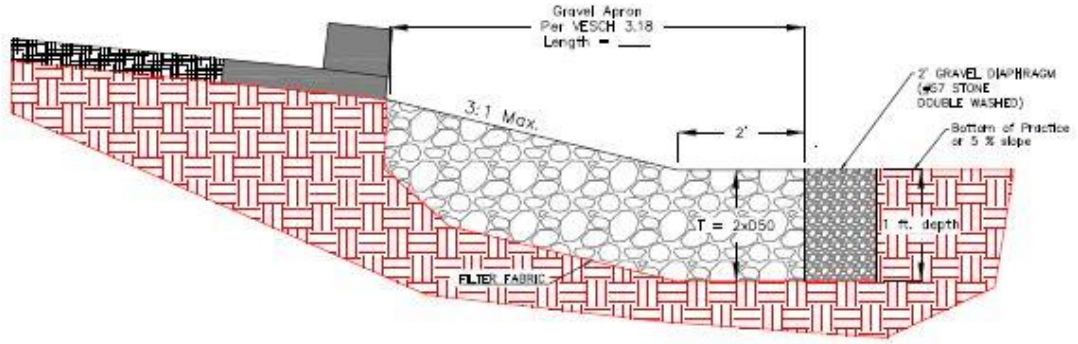
- Design flows should be less than 4 cfs.
- Curb cut width shall be 1 foot per cfs from the 10-year peak flow. Gravel flow spreader width shall be 2 times the width of the curb cut or channel bottom width.
- Maximum slope shall be 3:1 with side slopes of 2:1 whenever possible.
- Thickness of riprap slope protection and outlet protection apron shall be 2 times D50.
- The area below the flow spreader should be flat with no more than a 5 percent slope entering the practice.

Construction Criteria:

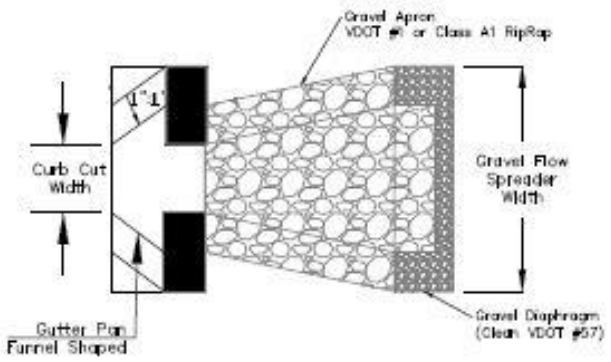
- Line with woven geotextile fabric.
- Add more curb cuts to reduce flow rate below 4 cfs.
- Cross slope of outlet protection apron shall be less than 5 % with the gravel diaphragm having a cross slope of 0%.

Maintenance:

- Periodic removal of sediments and debris.
- Monitor riprap and rock lining for movement and scour.



Profile



Plan View

Sediment Forebay

A sediment forebay is a settling basin constructed at concentrated discharge points. The forebay allows sediment and coarse debris to settle from the incoming stormwater runoff. Sediment forebays isolate sediment and debris accumulation in an accessible area which facilitates maintenance.

Design Criteria:

- Sized for 10 percent of treatment volume for small practices.
- Larger practices are sized to be 25 percent of the treatment volume and when there are multiple inlets with forebays, each individual forebay is sized on 10 percent of the treatment volume.
- For dry facilities, the forebay should also be dry with a pervious berm and weir.
- Depth of forebay should be 4 to 6 feet or follow the design criteria for dissipater pools in accordance with Chapter 10 of the Federal Highway Administrations Hydraulic Engineer Circular 14 (FWHA HEC-14).
- The weir should be non-erosive for the 10-year peak flow, with a minimum width of 6 feet per acre of contributing drainage area.

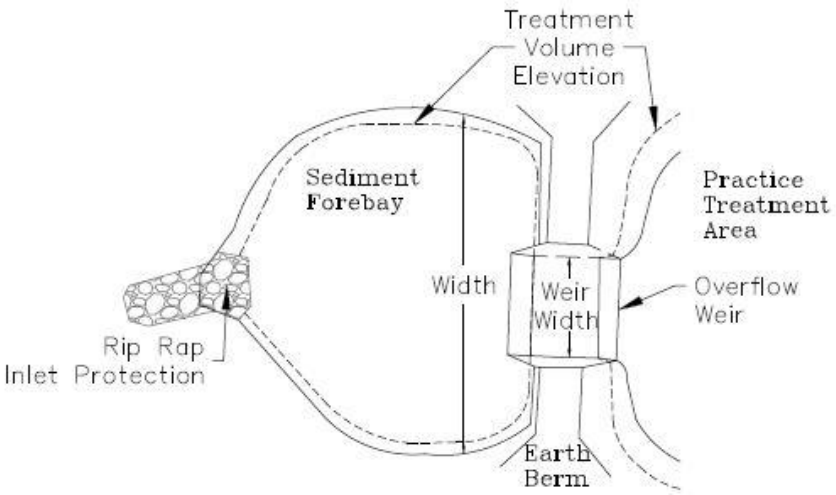
Construction Criteria:

- The forebay is built in conjunction with the inlet.
- Berm shall be compacted accordingly and tied into the side slopes.
- Permanent seeding applied immediately upon completion.
- Wet Forebays should have a suitable planting plant.
- Install appropriate outlet protection apron to all inlets in accordance with VESCH 3.18.
- Rock lining shall be used on inlet slopes greater than 5 percent.
- Stabilization Matting shall be used on all other inlet slopes.

Maintenance:

- Periodic removal of sediments and debris.

- Removal of unwanted vegetation that will clog the pretreatment
- Dredging of sediments once every 5 years.



Downspout Devices

Downspouts collect and convey coarse debris such as leaves, sticks and flower petals. Downspouts also collect fines from pollen and sediment to asphalt aggregate. The sediments and debris from a roof should be separated prior to entering a downstream stormwater practice. Generally two types of measures should be included, one to trap coarse debris and the other to filter out fines.

Design Criteria:

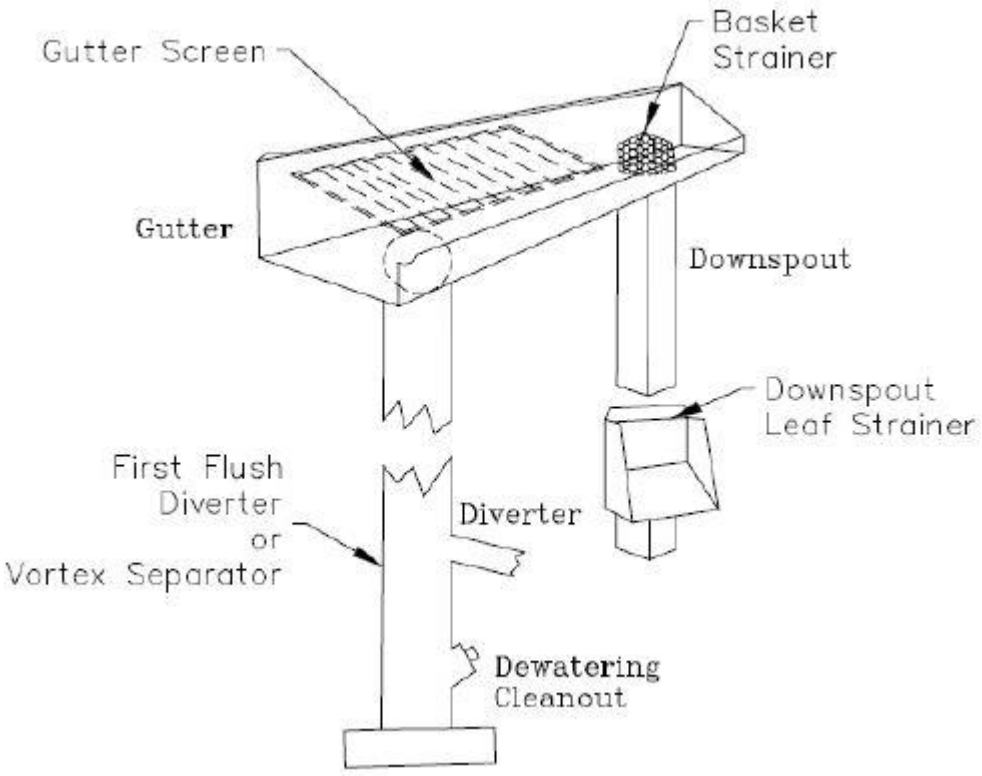
- Debris filters should have mesh screen with 0.95 mm openings
- First Flush Diverters are sized on 0.0125 gallons per square foot of roof area.

Construction Criteria:

- Install according to manufacturer specifications

Maintenance:

- Periodic removal of sediments and debris.


Gutter Screen
Basket
Strainer
Gutter
Downspout
Downspout
Leaf Strainer
First Flush
Diverter
or
Vortex Separator
Diverter
Dewatering
Cleanout

Appendix C – Reportable Measures for Crediting Urban BMPs for Chesapeake Bay Recovery Efforts

Overview:

This appendix provides guidance on the necessary data collection for BMP reporting to the Chesapeake Bay Program. Table C.1 is the crossover matrix for VCAP practices to Chesapeake Bay Model Practices and the necessary reportable. Table C.2 is the Project Tracking Document instructions.

Table C.1 Reporting Crossover Matrix

Reporting Crossover Matrix		Data Collection			
VCAP Practice Code	**CB Practice**	**BMP Extent**	**Impervious Acres Treated**	**Runoff Treated (Acre-Feet)**	**CB Model Reportable**
UNMP	Urban Nutrient Management Plan	Acres	----------	----------	Area Treated
ISR	Reduction of Impervious Surface	Sq. ft.	YES	----------	Area Treated
CL - Filter Strip	Disconnection of Rooftop Runoff	Sq. ft.	YES	----------	CDA
CL - Riparian Buffer	Stream Buffer	Sq. ft.	----------	----------	Area Treated
CL -Trees	Tree Planting	Sq. ft.	----------	----------	Area Treated
CL - Meadow and Mulch Bed	Vegetated Treatment Area	Sq. ft.	----------	----------	Area Treated
RG	Rain Garden	Sq. ft.	YES	YES	CDA
DW	Dry Well	Sq. ft.	YES	YES	CDA
CW	Constructed Wetland	Sq. ft.	YES	YES	CDA
VSC - DS	Dry Swale	Linear Ft	YES	YES	CDA
VSC - SPSC	Regenerative Stormwater Conveyance	Linear Ft	YES	YES	CDA
VSC - WS	Wet Swale	Linear Ft	YES	YES	CDA
RH	Cisterns & Rain Barrels	gallon	YES	----------	CDA
BR	Bioretention	Sq. ft.	YES	YES	CDA
IF - Surface	Infiltration Trench	Sq. ft.	YES	YES	CDA
IF - Underground	Underground Infiltration System	Sq. ft.	YES	YES	CDA
PP	Permeable Pavement	Sq. ft.	YES	YES	Area Treated
GR	Green Roofs	Sq. ft.	YES	----------	Area Treated
LS	Urban Shoreline Management	Linear Ft	----------	----------	LF

Table C.2 VCAP Project Tracking Document

Data Reporting Fields				
Field	**Required?**	**Description, purpose, and rules associated with the field**	**Example 1**	**Example 2**
Date Installed	Yes	Report the **year** the practice was installed.	3/15/2015	5/30/2014
BMP Name	Yes	Report the **practice name** either using Chesapeake Bay Program practice names, state practice names or facility-specific practice names.	TCN – Tree planting	RG
Practice Description	Yes	Report a description of what the BMP does or a definition.	An area of trees at least 35 feet wide on one side of a stream, usually accompanied by trees, shrubs and other vegetation that is adjacent to a body of water…	Small-Scale Bioretention implanted at the end of a downspout with no underdrain and using native soils. Landscaping is native plants…
Contributing Drainage Area	Yes, if 'Amount Applied' is not supplied	Report total site acres treated by the practice; includes the Impervious Acres.	N/A	0.1
Impervious Acres Treated	Optional	Report the number of impervious acres treated by the practice. If unknown or left blank, DEQ will assume the Total Acres Treated are 100% pervious urban.	N/A	0.057
Runoff Captured	Optional	If the BMP meets Virginia's performance-based water quality criteria, calculate the runoff captured in acre-feet.		0.0054
Amount Applied	Yes, if 'Contributing Drainage Area' is not supplied	Report the number of units implemented for each practice at the location.	0.5	N/A
Measurement Unit	Yes, if 'Amount Applied' is supplied	Report the unit of measurement for the value entered under "Amount Applied." Most common measurement units will be acres, linear feet, or pounds.	Acres	N/A

Data Reporting Fields				
Field	**Required?**	**Description, purpose, and rules associated with the field**	**Example 1**	**Example 2**
County Name	Yes	Report the name of the country in which the practice was implemented.	Culpeper	Farmville
State FIPS	Optional	Report State FIPs code where the practice was installed.	51047	51087
HUC12	Yes	Report HUC12 where the practice was installed, if available.	020802060105	020802070206
Latitude	Yes	Report latitude of practice, if applicable or available. If latitude and longitude are provided HUC12 and State FIPs are unnecessary.	DDD MM' SS.S"	DDD MM' SS.S"
Longitude	Yes	Report longitude of practice, if applicable or available. If latitude and longitude are provided HUC12 and State FIPs are unnecessary.	DDD MM' SS.S"	DDD MM' SS.S"
Inspect Date	Yes	Report each inspection date (i.e. Spot Check date) for the practice. If more than 5 inspections have been performed for a given practice, insert additional columns to accommodate.	None	7/1/2015
District Approval Date	Yes	Report the date the allocation was approved by the District Boards.	1/1/2015	5/15/2014
Grant Source	Yes	Report the grant source providing funding. If multiple grants, insert additional columns to accommodate.	NFWF	WQIF
Contract Number	Yes	Report the unique District identification number.	VCAP 07-15-001	VCAP 05-14-005

Appendix D – Unfunded Practices

Pet Waste Stations (PWS)
Urban Nutrient Management Planning (UNMP)

Pet Waste Stations (PWS)

Typical Pet Waste Station

The Environmental Protection Agency estimates that the typical dog produces three-quarters of a pound of waste per day. Left alone, pet waste can pollute ground and surface water, attract flies and pests, and transmit parasites and infectious diseases. Pet waste stations are designed to encourage pet owners to pick up after their animals in parks and other public places to prevent waste from being transported off-site by stormwater runoff. As illustrated above, pet waste stations typically include a covered 10-gallon waste can and plastic or bio-degradable "pick-up" bags attached to a sign-post that identifies the station purpose, and are installed at convenient locations where pet-walking and pet exercise occurs. However, where trash receptacles are already deployed in a public area, the waste cans are not an essential component of this BMP.

Policies Regarding PWS

Pet Waste Stations have relatively few practice constraints other than ensuring that the receptacles are located at places where pet owners are likely to have need of their services, they can be serviced and maintained by available staff, and the ultimate disposal facility will not of itself cause a water quality problem by concentrating the pet waste in or near a watercourse or in groundwater. This practice is a nonstructural BMP and is simple to implement.

A. Criteria

- This practice should only be installed in public areas such as parks, neighborhood common areas, apartment complexes, and similar public areas that are easily accessible and visible to pet walkers. .This practice is not designed for the individual homeowner.
- Receptacles should be safely located away from areas used for access by public utility service vehicles and must be at least 100 feet from water conveyance systems.
- Each station must have a professionally designed sign describing the use and purpose of the station. .Most commercial stations come with this type of sign.
- The waste disposal site will not of itself cause a water quality problem by its location to a watercourse or groundwater supply.

B. Plans and Specifications

- A final design plan for the site must be submitted by the applicant and approved by the Steering Committee before construction is initiated. The installed practice must be in accordance with the approved design unless changes were pre-approved by the Steering Committee. Information required in the plan includes:
    - Location within the property on a site map.
    - Site preparation details.
    - Provide Manufacturer specifications for installation, such as depth of posts and foundation materials.
    - Provide a waste disposal plan, if a trash can is included in the design.

C. Operations and Maintenance

- At least weekly service and maintenance for all stations that include a waste receptacle.
- Refill waste bags as necessary.

D. Cost-Share Rates

- After the initial purchase of the station, VCAP will not provide assistance for waste bags.
- VCAP will reimburse 75 percent of costs up to a maximum payment of $400.00 per station.

E. Helpful Technical Reference

- http://www.annapolisgreen.com/pdf/PetWasteStationCommProgHowToGuide.pdf

Urban Nutrient Management Planning (UNMP)

Surveys show that about fifty percent (50%) of homeowners fertilize their lawns, but fewer than 20 percent of those who fertilize consult an expert lawn professional or take a soil test to determine the optimal fertilization strategy. Nutrient export associated with turf grass fertilizer use from home, commercial and industrial lawns depends on various landscape factors, fertilizer application rates and overall lawn care practices. Having an urban nutrient management plan developed ensures an optimal fertilization strategy will be implemented and helps to reduce nutrient export from fertilized lawns.

Policies Regarding UNMP

Urban Nutrient Management plans (UNMP) have relatively few practice constraints other than: the area associated with the plan must currently be fertilized or have a critical need to be renovated because of poor or no vegetative cover, the property owner agrees to keep fertilization records regardless of who is making the applications, the property owner agrees to have a certified fertilizer applicator apply all fertilizer in accordance with the plan or the property owner demonstrates they have the necessary knowledge along with proper application and calibration equipment to apply the fertilizer themselves.

Definitions:

An **amended** Urban Nutrient Management Plan is a current UNMP that has been updated to accurately match current landscape management practices. Plans only need to be amended if changing of landscape plants or turf grass species drastically alters the optimal fertilization strategy outlined in the current plan.

A **revised** Urban Nutrient Management Plan is an expired UNMP that has been rewritten to accurately match actual landscape plants and/or lawn management practices.

A. Ranking and Priority (high and low)

- Proximity to stream, river, storm drain, or bay (within 300 feet = high priority).
- Very High (VH) Virginia Tech soil test phosphorus fertility rating or correlated to VH from another lab.
- Area was previously over fertilized compared to DCR guidelines.
- Newly established turf.
- Fertilized areas have slopes greater than 15% (and account for 33% or more of the landscape).
- High water table.
- Soil types: shallow soils, sandy soils or karst terrain.

B. Criteria

- This BMP applies to fertilized turf grass landscapes and other ornamental plant landscape areas that receive nutrients at least once in a three year period.
- In order to be eligible for cost-share, urban nutrient management plans must be prepared by a private planner who holds a current Nutrient Management Planner Certificate in the Turf and Landscape Category issued by the Virginia Department of Conservation and Recreation. Urban Nutrient Management Plans must be written to comply with all requirements set forth in the Nutrient Management Training and Certification Regulations, (4 VAC 50-85-10 et seq.) and the criteria set forth in the Virginia Nutrient Management Standards and Criteria, revised July 2014.
- Plans must be developed based on soil analyses taken within a three year period prior to plan development and must be performed by soil testing laboratories approved by DCR.
- Before cost-share payment can be made the following items must be submitted:
    - A complete copy of the Urban Nutrient Management Plan, containing the planner's Virginia Nutrient Management Certificate number.
    - An invoice for planning services from the private certified planner.
    - If the participant is seeking cost-share for a plan previously written under this specification, fertilizer application records and the previous plan must be presented to SWCD staff for review.

C. Plans and Specifications

- Urban Nutrient Management Plans will be prepared to include all necessary information as outlined in the Nutrient Management Regulations 4 VAC 50-85-10 et seq. Outlined plan content can be found at: http://www.dcr.virginia.gov/soil_and_water/documents/nmtmsc- tl_plan_checklist.pdf

D. Operations and Maintenance

- Participant is required to keep all fertilizer records regardless of who makes the applications.
- Participant is responsible for notifying the certified planner when landscape plants or lawn care practices have changed, warranting amendment of the plan.
- Participant is responsible for maintaining adequate vegetative cover.
- All plans are subject to spot check procedures and any other quality control measures.

E. Cost-Share Rates

- VCAP will reimburse up to $100 per parcel per year. If the plan is written through a Virginia Cooperative Extension Master Gardener program, the maximum allowable reimbursement is equal to the fee associated with the Master Gardener program.
- Participants may redirect their cost-share payment to their private certified nutrient management planner by signing a written statement to that effect. A sample statement is attached to this specification

F.Helpful Technical References

- Chapter 13 of the Urban Nutrient Management Handbook
- Nutrient Management Standards and Criteria Revised July 2014
- Fertilizer Applicator Certification Training (FACT)
- Fertilizer calculator